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CONTENTS

Special Features

The Time for Courage 75

Cut Bank Absorption Plant Especially Designed for Unusual Weather Conditions 76

A Study of Bleaching Clays 80
P. G. Nutting

Cracking Installation Adapted to Processing Asphalt 83

Need for Construction Seemingly Is a Paradox 85
George Reid

Utility of Graphical Charts in Design and Operation 88
C. M. Johnson

The Construction of Graphical Charts 93
A. B. Steen

Preparation of Ethyl Alcohol from Ethylene 96
V. Gerr, O. Pipik and E. Mezhebovskaya

Cost Accounting and the Chemical Engineer 100
A. G. Peterkin and H. W. Jones

Standard Costs in the Oil Refining Industry 104
G. Carter Harrison

Regular Departments

Editorial 75

Science and Technology 28a

The Month in Review 37a

Plant Activities 40a

New Equipment for the Modern Plant 42a

Items About Manufacturers 46a

Catalogs—Bulletins 46a

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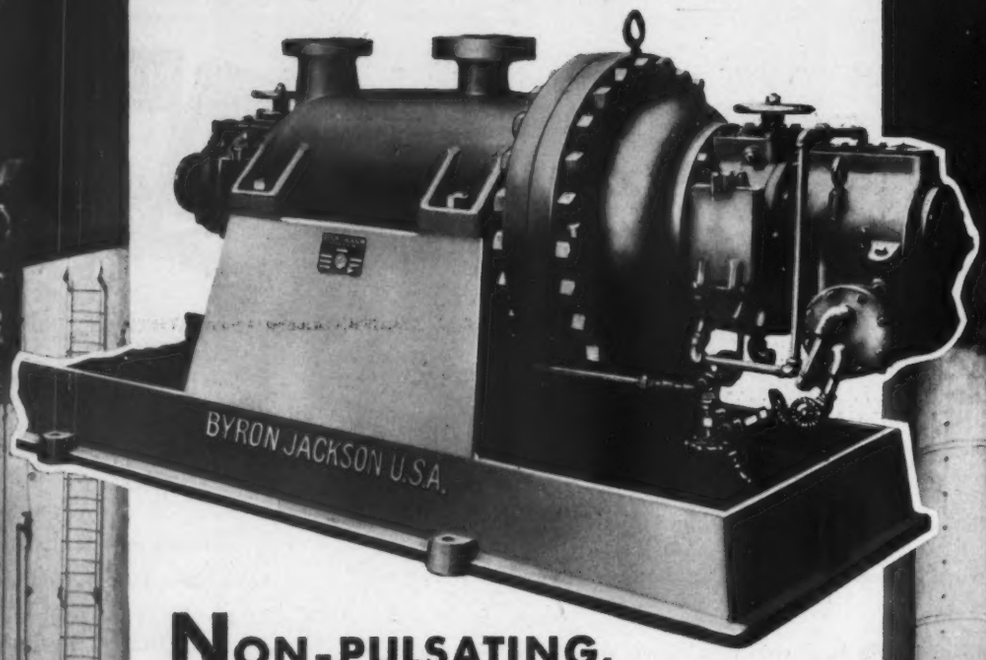

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The Time for Courage

IT is to the credit of the American people that the effect of a revolution can be accomplished without the disaster common to such events. Yet within a week the end of one order of things was sealed and another begun. What this new order is no man can define. That a new order has begun is true because another one failed.

One generation has learned at last that it is impossible to establish a prosperity by the mere spending of money. As we learned many times in the past, another people know that even the backing of a gigantic government is not enough to save that which is not needed. There is no virtue in reflecting on the fact that this people might have read the pages of history and have known that the unnecessary is not to be maintained regardless of the amount of credit administered for the purpose.

Deflation marched a devastating path for more than three years. Still that was not enough. True values finally had to be written and the writing had to be so swift that the financial structure of the United States could not withstand the impact. The only course open was to paralyze the financial structure and let the new values be written while the holders of commodities could not translate physical property into cash.

Criticism has a small place in the needs of this day. It ill becomes an individual to criticize government for its pumping of credit into the economic system, because industry has itself practiced similar tactics. It has been present within the petroleum industry. Proration has been but an effort to maintain all the concerns and all the individuals in their efforts to drill wells into all the oil sand they could find.

Just as a farm board can not establish a price for wheat when it has no control over the planting of wheat, so no industry can keep its corporations and its individual solvent as they produce more and more of a product that is all the while in excess of current needs.

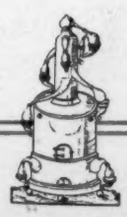
Men of the petroleum industry have known for four years that there is no need for the more than 300,000 outlets for gasoline in the United States. What they knew brought no curtailment; now the stern hand of economy has taken the seat that sound judgment might have occupied and the number of service stations will be reduced.

Individually each concern and each individual can justify individual refining capacity and refinery output. Collectively too much gasoline has been made, as many admit. Again it is the hand of economy that will dictate the course of restriction.

This is no day for vaunted optimism. It is a day for courage. No nation forced to the extremity of impounding its gold and closing the doors of its banks warrants the estimate that it stands supreme and unshakable. Still the cause for courage lies in the fact that it has the gold, the currency and the commodities essential for life. Both courage and wisdom must be exercised to their last leverage in order to bring out our resources into another workable scheme for the movement of the necessaries of life.

This nation faces a day when spiritual values will outrank material values. It faces a day when the cost of all government will not exceed fourteen billion dollars. It faces a day when men will not see their savings vanish by the visit of the tax collector. It faces a day when twelve million men will not be idle.

That day will dawn the sooner if men put away emotion, forget much of what was, and chart their courses by the sober reading of facts.

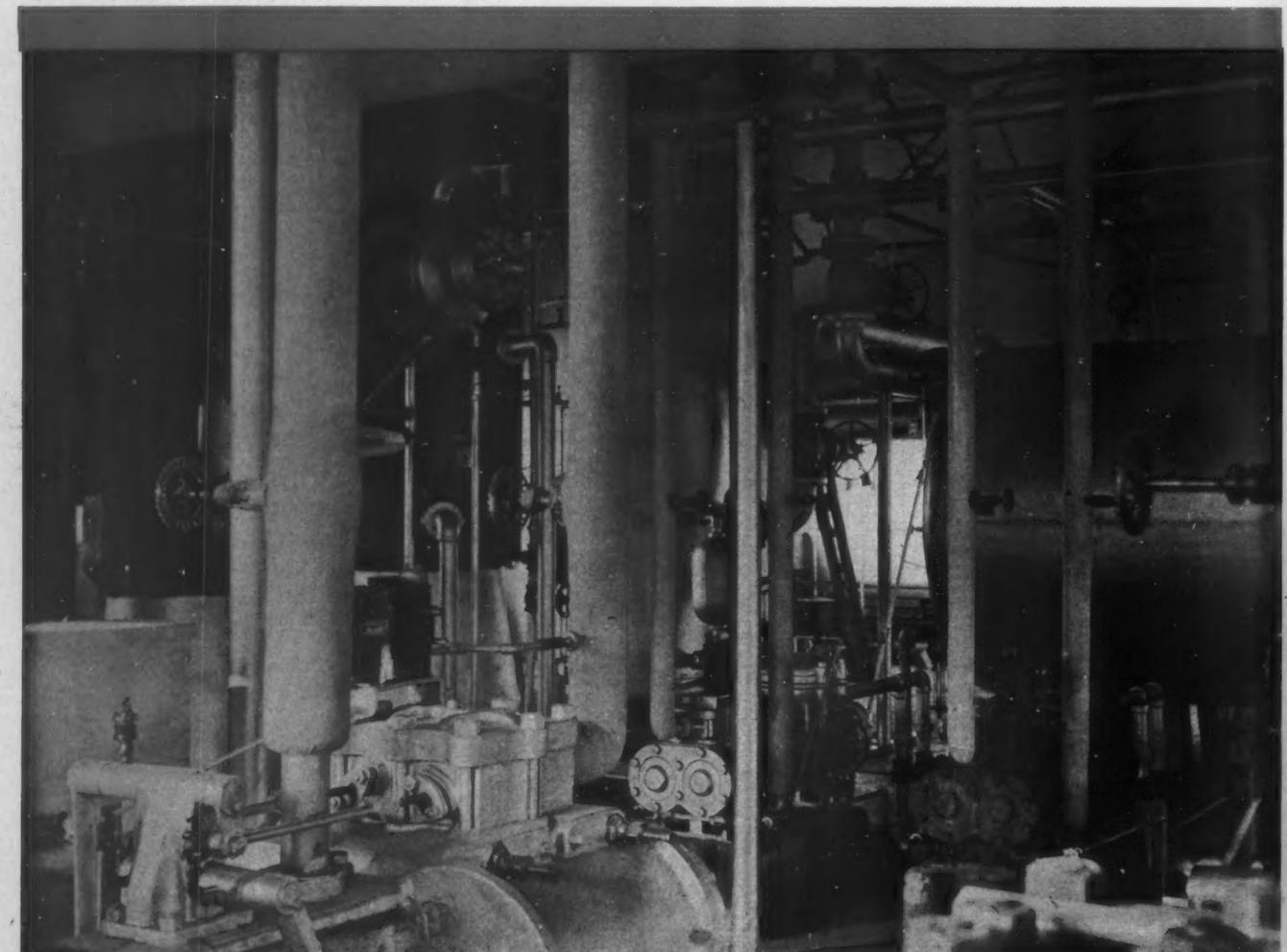


Cut Bank Absorption Plant

Especially Designed for Unusual Weather Conditions

THE natural gasoline absorption plant near Cut Bank, Montana, completed late in December for The Montana Power Company, contains a number of unusual details designed for the purpose of meeting the extremely severe weather conditions. The plant is located about four miles east of the town of Cut Bank, on the Great Northern Railroad, where The Montana Power Company's 20-inch gas line, terminating 280 miles south at Butte and Anaconda, crosses the tracks. The site is at an altitude of 3800 feet, in open prairie country subject to almost unceasing winds ranging in velocity from 10 to 80 miles per hour. Winter temperatures regularly reach a minimum of 40° to 50°F. below zero; frost penetrates the ground to a depth of five to six feet.

The gas comes under natural pressure from wells in the Cut Bank gas field, at an average distance of about 10 miles from the plant. It contains about 0.25 gallon per thousand cubic feet of 22-pound Reid vapor pressure, 96 to 97 per cent recovery natural gasoline. The gas line is designed for a full-load capacity of 60 million cubic feet per day with a pressure in the line of 400 pounds per square inch at the field end. The present winter peak load runs around 25 million feet per day,

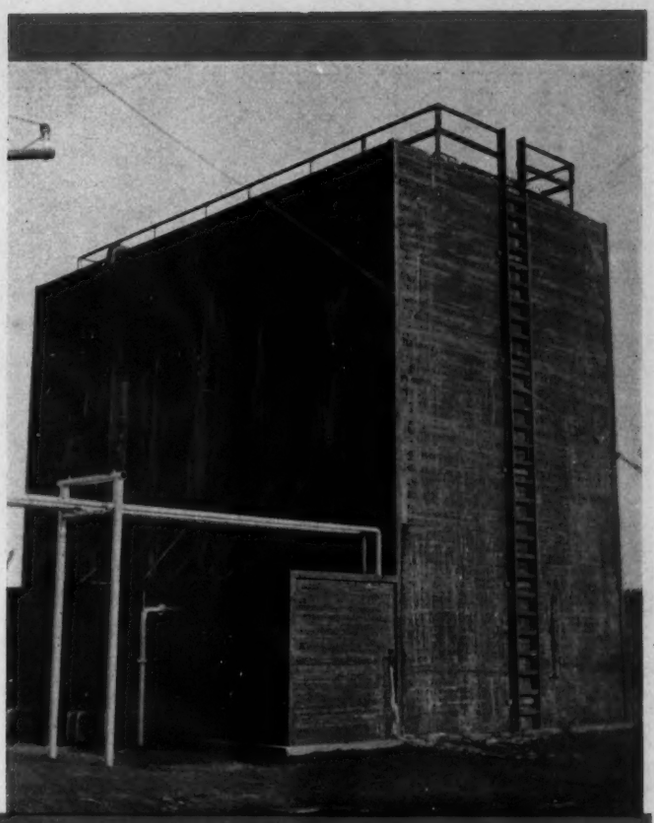


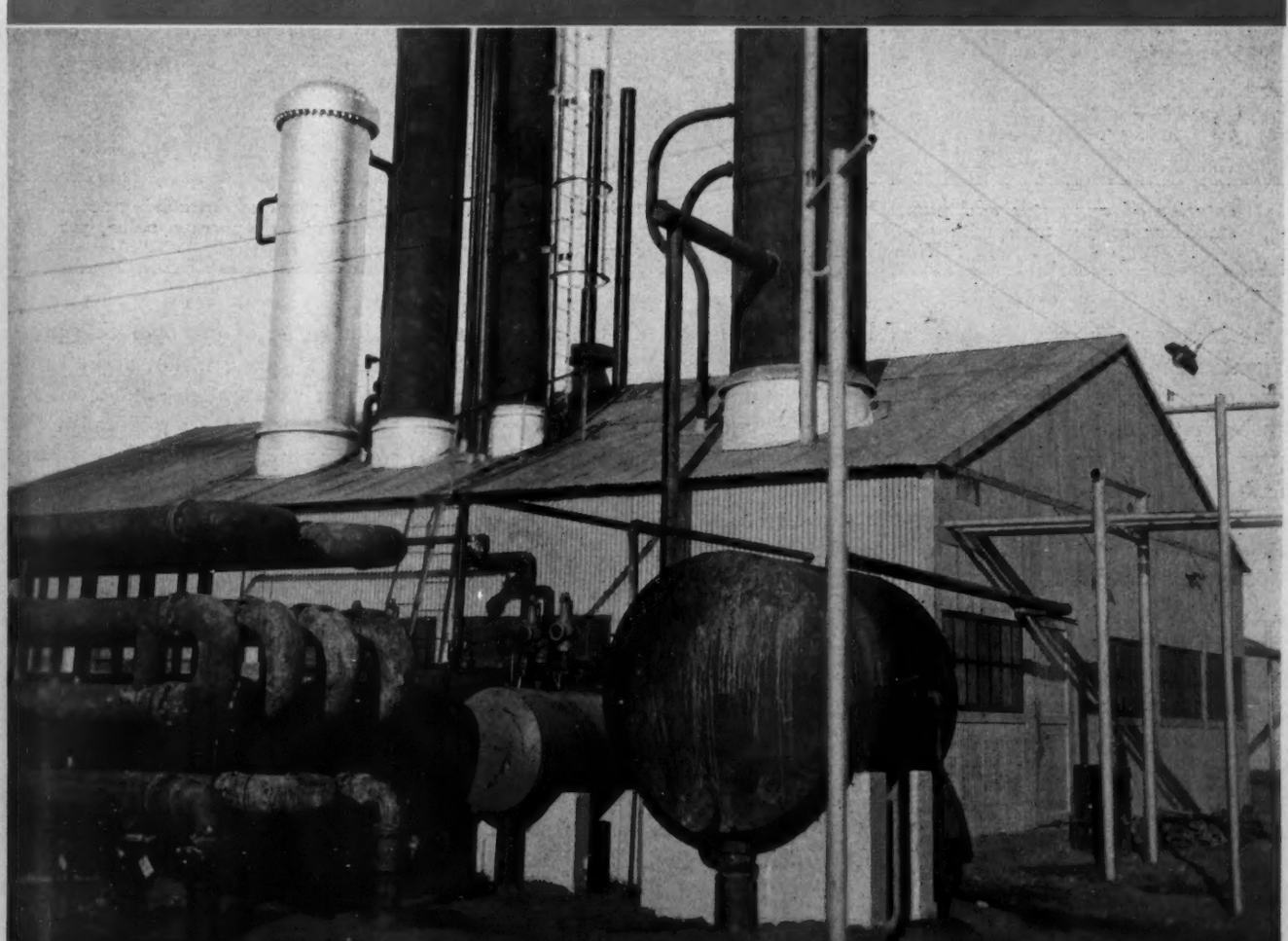
Inside apparatus and pump house, Montana Power Company's absorption plant at Cut Bank, Montana. In the background, left to right, stabilizer column, reabsorber, high pressure absorber, gasoline surge and dewatering tank

and the pressure at the plant is maintained at about 300 pounds per square inch.

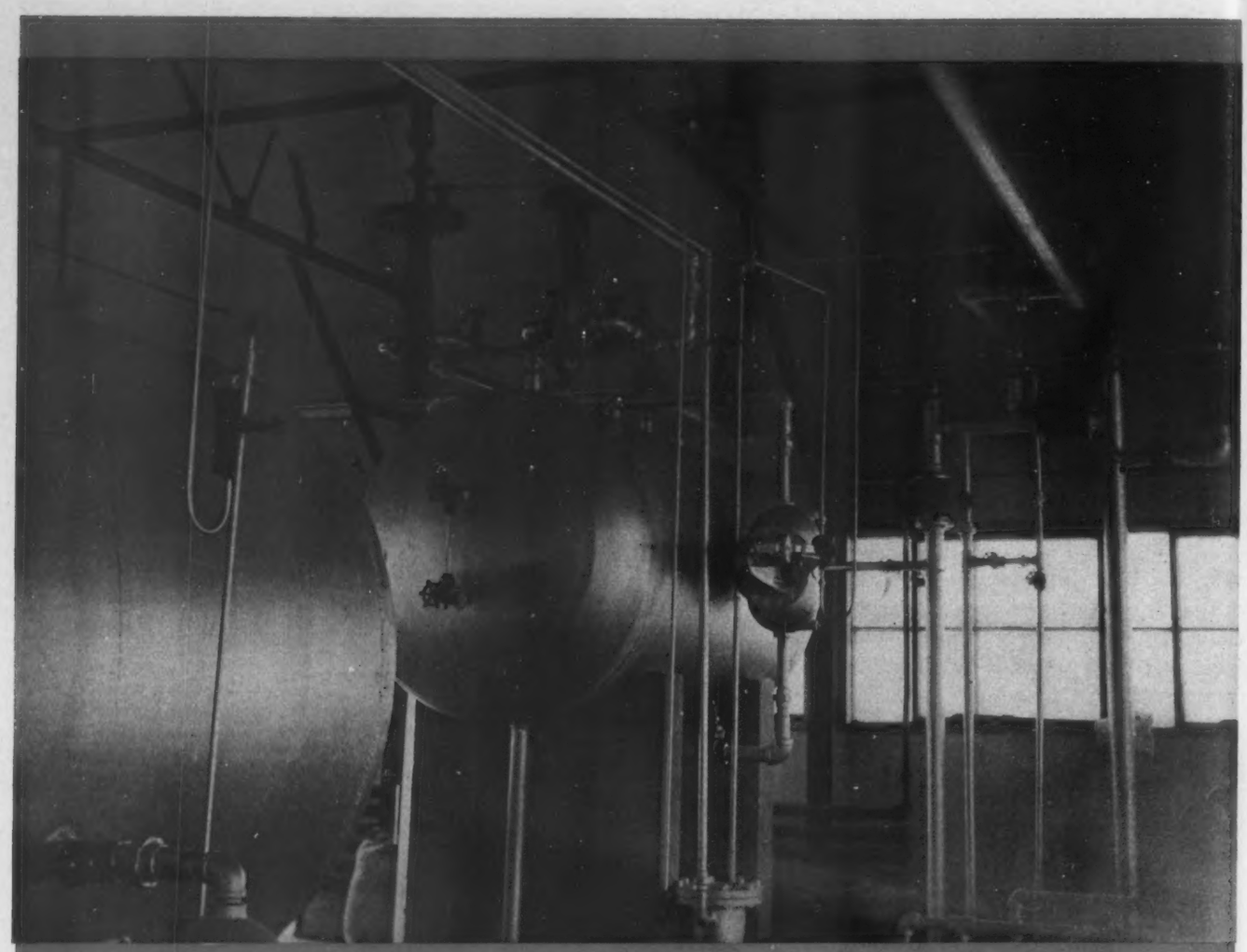
In view of the fact that it will probably be several years before the gas load is built up to the full line capacity, the plant is designed so that equipment may be added as required to handle the actual loads efficiently. The still, vapor reabsorber, high-pressure stabilizer, and all plant pipe lines are designed to handle the ultimate load, but the high-pressure absorber, oil heat exchanger, preheater, most of the cooling, boiler plant and fixed gas recompressor unit are designed for the present load, with space and connections provided for putting in the additional units when needed. In this way the initial investment was kept down to a reasonable figure, and yet the full-capacity plant will cost but little more than it would have if built all at one time. In the meantime, while the load is being built up, the operation is not burdened with capital charges on idle equipment.

The flow-sheet of the plant follows more or less conventional lines for lean-gas plants. The fat oil leaving the high-pressure absorber is flashed to a pressure of about 90 pounds per square inch in a primary weathering tank; then passes through the heat-exchanger, and is again flashed in a secondary weathering tank at a pressure of about 50 pounds per square inch; from this





On the ground, left to right, heat exchanger, secondary weathering tank, primary weathering tank, hot lean oil surge tank. Through the roof, as shown on opposite page. Above special designed cooling tower.



Interior of apparatus and pump house, showing, left to right: End of raw gasoline surge and dewatering tank, stabilizer reflux tank with stabilizer pressure regulator and reflux control float case and diaphragm valve, gas line from re-absorber to fuel system and recompressor

tank it passes through the steam preheater and into the fractionating still, which operates at 30 to 35 pounds per square inch. The lean oil leaving the still passes through the exchanger, and is then pumped up to a pressure sufficient to put it through the final oil coolers and into the high-pressure absorber. A reabsorber operating at 28 pounds per square inch pressure recovers the useful materials in the vapors from the two weathering tanks and the gasoline condenser. The plant fuel supply is taken from the stripped vapors leaving the reabsorber, and the excess above fuel requirements is returned to the main gas line leaving the plant by a two-stage gas engine driven compressor.

Gasoline vapor from the still is condensed and run to a large combination surge and dewatering tank, from which the still reflux and stabilizer feed pumps take suction. Finished gasoline from the high-pressure stabilizer is treated for sourness with calcium hypochlorite solution, and is then run to storage.

Steam is supplied by two Stirling type water-tube boilers, operating at 175 pounds per square inch gauge. Either boiler is large enough to carry the present full load.

On account of the wide range of gas operating pressure (250 to 400 pounds per square inch), and also of volume to be treated, which varies at present from six million per day in the summer to 20 million in the winter, direct-acting steam pumps are used for handling all liquids in the plant.

HEATED BUILDING

In order to reduce operating difficulties due to the low winter temperatures, practically all of the absorption and distillation equipment is housed in a large steel-frame building which is lined and steam-heated. This building encloses the main gas scrubbers and the bases of all the absorbing and fractionating columns, with their associated float controls, instruments and accessories, the pumps, the raw gasoline surge tank and stabilizer reflux tank, and the hypochlorite treating unit. The interior of the building is heated by steam in six two-inch pipes running practically all the way around the walls under the windows; this heat, together with that given off by the pumps and apparatus, keeps the inside temperature comfortable in the most severe weather. The walls and roof are insulated with ordi-

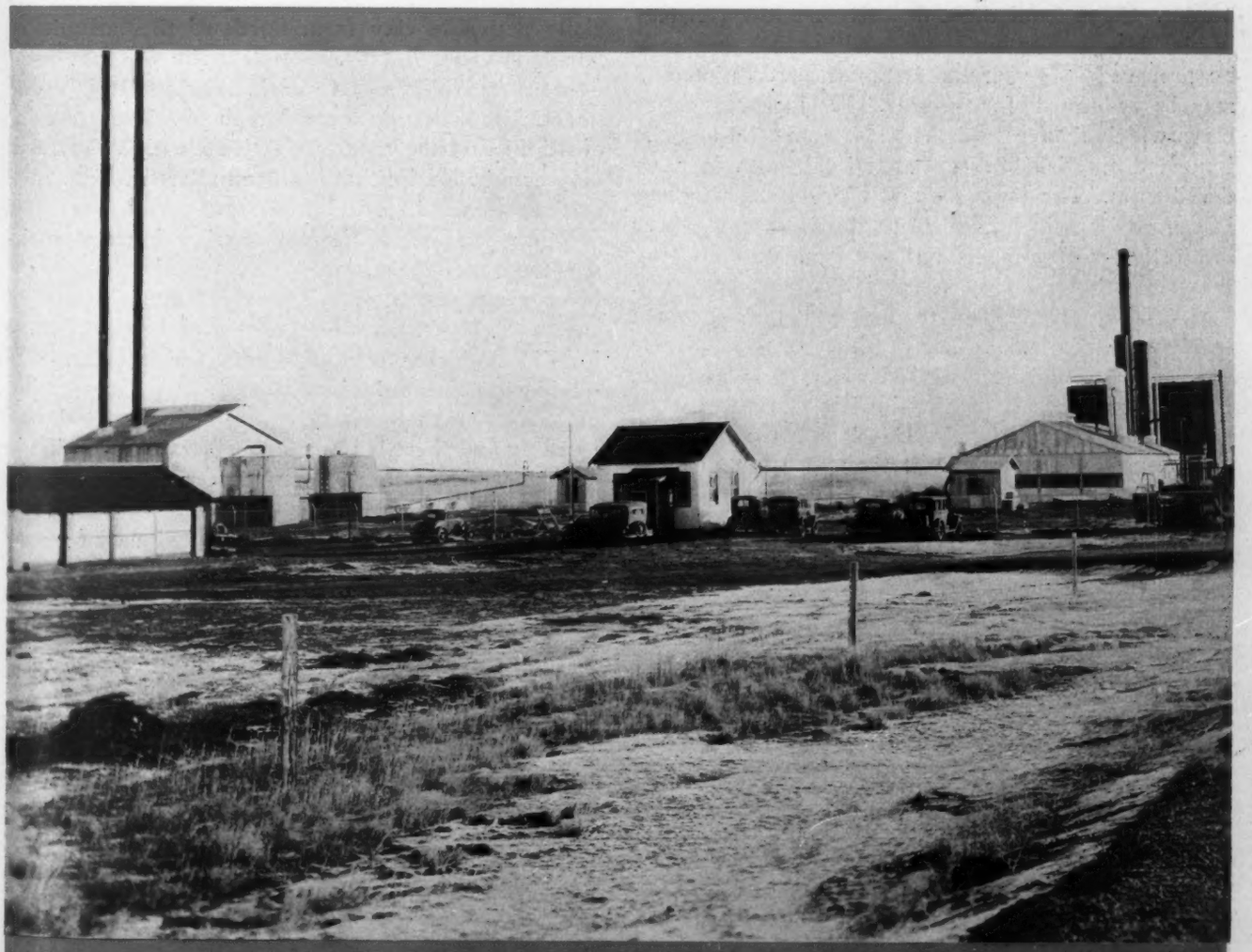
nary wall-board, nailed to wooden furring strips secured to the steel frame.

All cooling is done in open or atmospheric type cooling sections, mounted in a cooling tower specially designed to meet the conditions. The tower consists essentially of a box provided with water sprays at the top, and open along both sides at the bottom, with solid fences spaced out from the tower at the bottom to break the direct passage of wind through the bottom. Hinged hatch covers extending from the tower walls to the fences permit adjustment of the amount of fresh air circulating through the tower to suit wind and temperature conditions. Even under the highest winds water-loss through drift from the tower is negligible, and freezing can be easily controlled by adjustment of the hatches.

In order to eliminate trouble from freezing of water precipitated in the finished gasoline storage tanks, a small amount of steam heat is applied to them. The tanks are 10 feet, six inches diameter by 40 feet long, painted with aluminum paint but uninsulated. The heater consists of a three-inch pipe, closed at one end, running the length of the tank inside at the bottom, with the open end welded through one head. The pipe is held in place by three loose-fitting sleeves which are welded to the bottom of the tank; thus it is free to expand and contract in length, but cannot become displaced if the tank is moved. Steam is applied through a one half-inch pipe running inside the three-inch pipe from a hand throttle at the open end to the closed end. It has been found that this heater keeps the tank temperature well above freezing during the coldest weather, with a trifling steam consumption.

All yard piping in which flow is continuous is buried at least four feet below the surface. Those lines in which the flow is very slow or intermittent are buried six feet. Where lines come near the surface to enter the apparatus houses they are packed in wood chips in wooden boxes. Steam is transmitted through insulated overhead lines.

The plant was built under general contract by The Stearns-Roger Manufacturing Company of Denver; the apparatus designs and general engineering were furnished by Parkhill-Wade, Inc., of Los Angeles, successors to J. A. Campbell Engineering Corporation. Construction work was started October 15, and the plant was placed in operation December 20, 1932.



General View of Montana Power Company's Cut Bank, Montana, Absorption Gasoline Plant. It was built especially to fit weather conditions in that area.

A Study of

Bleaching Clays

P. G. NUTTING

THERE is an abundance of bleaching clays of the highest grade in this country but general knowledge as to their location, behavior and uses is limited and considerable bleaching clay is imported. Two years ago a systematic study of the properties of such clays was undertaken by the United States Geological Survey. A preliminary report on the chief commercial bleaching clays and methods of studying their properties was published in the January 15, 1932, number of Industrial and Engineering Chemistry. This article is a summary of the more important results obtained since that time.

Of the naturally active clays, the bulk of the production, amounting to upward of 200,000 tons annually, is from an extensive group of deposits 100 miles long and 30 miles wide astride the Georgia-Florida border. Clays from these deposits are low (0.7-0.9) in bleaching power but are valued because they may be prepared in grannular form for percolation and may be re-burned for re-use. The Japanese active clays which I have explained rate about 1.3 and the imported English "fuller's earth" 1.2, both in powdered form. The Japanese and Florida clays are not improved by acid leaching but the bleaching power of the latter clay may be raised from 0.7 to 1.2 by dialysis and to 1.8 by a special cation treatment. There is a naturally active, magnesian clay, mined in Nevada near Death Valley, which rates 1.8 merely dried and ground but only 1.2 after the acid leach. Naturally active clays are mined in central Georgia and near Creede, Colorado, chiefly for the cotton oil trade. It is said to cost less than $5 a ton to mine, dry and mill a clay in a modern plant. Freight charges are being reduced on this class of material (billed as "ground clay"), the higher rates on treated clays being retained.

ACTIVABLE TYPE CLAYS

Clays of the inactive but activable type are largely bentonites, originally volcanic ash but decomposed and partly leached. These are widely distributed and each bed covers a large area, but is usually too thin to be of commercial interest. One horizon characterized by probably discontinuous beds of bentonite extends from Canada to northern Alabama but is only two feet thick in eastern Tennessee and northern Alabama and five feet at High Bridge, Kentucky. Many western deposits are much thicker.

Where bentonites have been carried and redeposited by water, they are usually mixed with ordinary clay and silt. Most of the Oklahoma and Texas activable clays appear to be of this character. While pure bentonites such as those from near Otay, California, Chambers, Arizona, and Westcliffe, Colorado, activate to a ceiling of 2.0 these Mid-Continent impure bentonites activate to 1.3 to 1.7.

In some other bentonites the decomposition has not progressed far enough to render them readily activable. Either the volcanic ash was originally too silicic or the climatic and other physical conditions were not favorable for a decomposition to a highly activable type of clay. Those of Wyoming, South Dakota, western Montana, and Alberta, appear to be chiefly of this class. No naturally active or commercially activable clay from north of the latitude of Richmond, St. Louis and Salt Lake has yet been found. The fuller's earth of Massachusetts is a fine quartz silt which does not bleach oil. There are indications that the naturally active Death Valley clay may be a bentonite that has been altered to an active state by unusual natural processes.

Many samples of ferromagnesian igneous rocks decomposed in situ, have been tested which show bleaching power after acid leaching equal to that of the best clays. However, these are commonly too local in character to be of commercial interest. The olivine-serpentine dunites occur in large masses but at best they rate only 1.2 after grinding and acid leaching and there is always considerable variation in quality within a short distance.

A third possible major source of bleaching material is the very abundant and widely distributed marine mineral glauconite, commonly called greensand. This is a complex ferromagnesian silicate supposed to have been formed off shore at the "mud line" of the ocean in 10 to 100 fathoms of water, probably in connection with animal life (foraminifera), and now found in deposits of varying thickness along the Eastern Coastal Plain. These deposits are described in U. S. Geological Survey Bulletins 660-B and 727. One deposit extends from New York City across New Jersey and Maryland just above tidewater. Similar deposits occur in Australia and many other localities. Quartz sand and clay are common impurities but are readily removed. The mineral proper varies between the end members.

$2H_2O.K_2O.2(Mg,Fe)0.2(Fe,Al)_2O_3.10SiO_2$
$2H_2O.K_2O.(Mg,Fe)0.3(Fe,Al)_2O_3.10SiO_2$

THREE important groups of clays—natural active clays, activable bentonites and glauconites are discussed in the accompanying report by P. G. Nutting of the United States Geological Survey. This is the second report by Mr. Nutting, the first, a preliminary report on the chief commercial bleaching clays was presented in these columns, in the issue of April, 1932, page 286.

In the present work Mr. Nutting calls attention to the wide variety of bleaching clays available in the United States, listing the properties of 30 such products. Available clays in this country can replace the costly imported bleaching materials.

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Glauconite was long used as a natural fertilizer. It has been worked for potash, for iron salts and for silica and is being used as a base exchange water softener. It grinds readily in a flour mill and the raw ground glauconite (300 mesh) is an excellent bleach for cotton oil. For mineral oil (contact process) it must not only be ground but acid leached. It yields readily to acid, going over to a material resembling silica gel, which is not a good bleach (1.0) for mineral oils. Control of leaching through control of time, temperature or concentration of acid is not possible as some grains leach far more readily than others.

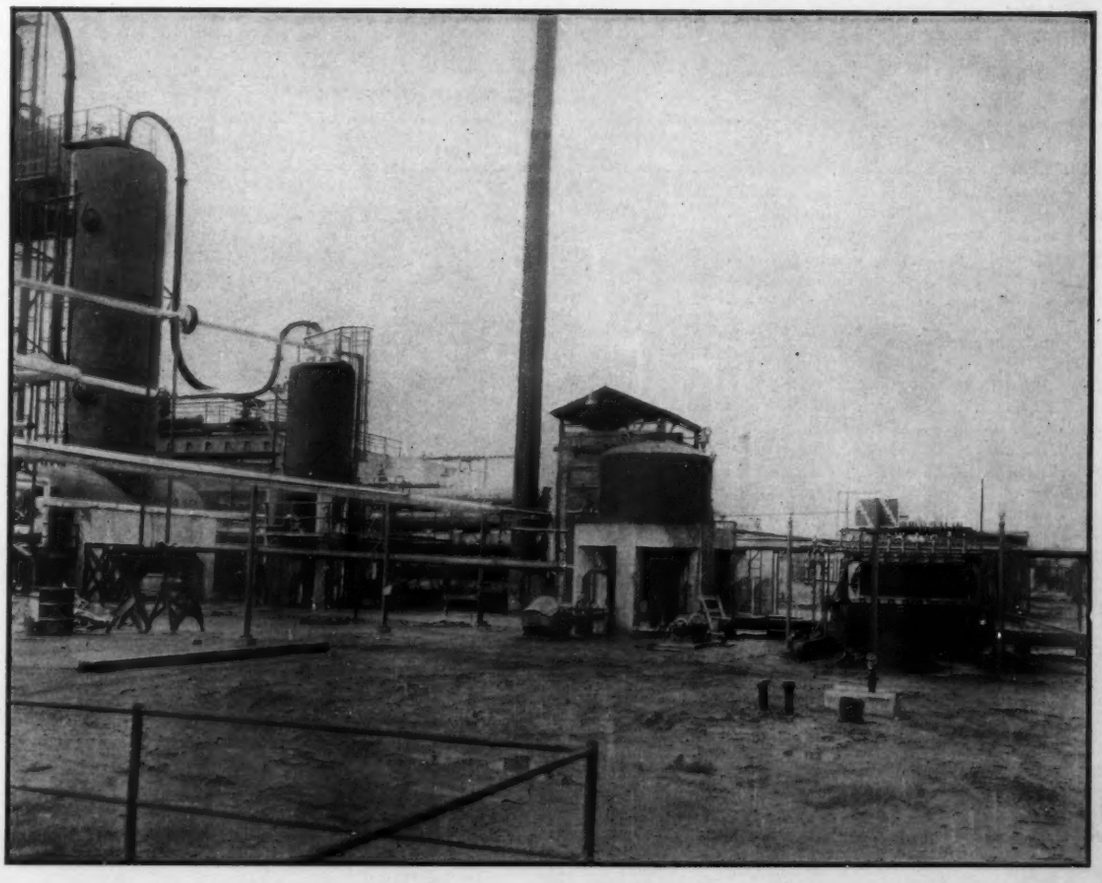
In an attempt to limit and equalize the leaching, I added salts to the leaching acids (the chlorides of Fe, Al, Mg, etc. to HCl, or the sulphates to sulphuric acid) and found that the leaching progresses to a maximum activity (equal to that of the best treated clays) and then stops, due apparently to the excess of cations present in the leaching solution. Incidentally I find that the same process is applicable to those bentonites which yield too readily to acids, going over to near pure silica. Even the naturally active Georgia-Florida clays are very materially improved by this process of subjecting them to a hot solution of mixed salt and acid. Table 1 gives in outline the effects of various treatments on type clays. The rating given is the ratio of the volume of black crude which is bleached water white to the volume of clay bleaching it. I have no theoretical explanation of the effect of the improved leach but it may be a base exchange between salt and clay, catalyzed and carried farther by the acid.

TABLE 1—EFFECTS OF CLAY TREATMENTS

	Not treated	Dialyzed	Acid leached	Salt and acid solution
Florida clay	0.7	1.2	0.6	1.8
Bentonite	0.5	0.6	1.5-2.0	2.0
Glauconite	1.2	1.2	1.0-1.7	2.0
English earth	1.2	...	1.6-2.0	2.0
Death Valley	1.8	1.6	1.2	2.0

BEHAVIOR OF CLAYS

Bleaching tests of various clays made on reduced cylinder oil, crankcase oil, fish, linseed and cotton oil and on lard have been made in a study of the be-



Osterstrom Treating Process Developed by The Pure Oil Company

havior of the different types of clays. In the tabular report in Table 2, however, the semi-absolute scale of bleaching power on cold crude petroleum is adhered to. For many of the clays cited in this table little is known of the extent of the deposits and the tests reported give only a hint of possible usefulness.

Clays 1-9, 11 and 18 are well known commercial clays; 10 is a decomposed olivine rock from near Webster, N. C.; 12 and 13 are pink bentonites from Colorado; 14 is a similar bentonite from Santa Rita, New Mexico; 15 is a brown waxy bentonite from near Laurel, Miss.; 16 is a green bentonite from eastern Tennessee; 17 is a sedimentary clay, possibly a reworked bentonite from a bank of the Tennessee River, sent in by Prof. Walter H. Bucher of Cincinnati; 19 is a "fuller's earth" supplied by a chemical supply house; 20, horny white halloysite from near Rome, Georgia; 21 is from the five-foot deposit being worked near Woodward, Oklahoma, apparently an impure bentonite; 22, bentonite from Saline County, central Arkansas, submitted by State Geologist J. C. Branner. 23, 24 and 25 are central Georgia clays submittted by Poole Maynard, Atlanta; 26 is an Ordovician bentonite, greenish gray, like shale in texture.

These selected tests well represent the gamut of variation in our American clays. There is a well-defined ceiling in bleaching power (2.0) approached by many of these clays but exceeded by none. Active synthetic mixed oxides approach the same ceiling but are expensive to prepare, hence the market for bleaching clays is unlikely to be disturbed from that quarter. The single clay (No. 5) that is highly active when untreated is so situated as to be only a competitor of the treated clays. Losses on acid treating (5 to 43 per cent) and recoverable by products vary over a wide range.

Two considerable improvements are to be expected in the production of bleaching clays; (1) the development of high grade sources nearer points of consumption, thus eliminating freight charges often over half the delivery cost and (2) improvements in treating to bring out maximum activity. In addition, special oils and fats will always require special clays, specially prepared. Acid treated clays fall off rapidly in bleaching power when exposed to air, this effect should be further studied. Activated alumina and treated slag are particularly susceptible to deterioration of this nature.

Some clays appear to leave the bleached oil more stable in color than others. For each clay there appears to be an optimum temperature of bleaching activity which has been but little investigated. Some clays crack even pure saturated paraffins (such as laxative oil or fused paraffin wax) while others do not. Drying conditions profoundly affect the bleaching power of some clays. Some cease bleaching abruptly while others give a long series of intermediate green, yellow, orange and red oils. The bleaching power of some clays is unaffected by ignition while that of many clays is destroyed. One clay is inactive on hot crude when raw but is highly active after acid leaching while on cotton oil its action is just the reverse. Finally the uses of active clays as catalysts for chemical reactions, as absorbents for the selective recovery of solvent vapors, as water softeners and other agents remain to be investigated and developed.

TABLE 2—CLAY TESTS

	Bleach		Acid	Solution				Weight loss ° C.	
	Raw	Ac. Ttd.	Sol	Fe	Al	Ca	Mg	25-160	160-800
1. Attapulgus	0.8	0.5	18.6	4	5	1	1	3.2	9.6
2. Quincy	0.7	0.6	25.6	4	3	3	*	4.6	10.5
3. San Antonio	0.7	1.1	11.1	6	3	1	*	1.5	5.2
4. Olmstead	0.6	0.3	23.3	7	3	0	*	2.3	5.1
5. Death Valley	1.8	1.2	24.9	*	1	1	8	3.2	6.2
6. Tehachapi	1.1	1.1	13.1	4	4	*	2	5.6	7.0
7. Chambers	0.6	2.0	22.6	5	4	1	*	6.8	8.1
8. English earth	1.2	2.0	19.9	5	4	1	*	9.0	5.7
9. Japanese	1.0	1.1	14.2	3	6	1	0	9.1	5.3
10 .N.C. dunite	1.2	1.2	40.0	5	0	0	5	4.1	9.2
11. Otay, Cal., Bent.	0.5	1.8	31.3	2	8	*	0	11.3	5.2
12. Silver Cliff	0.8	2.0	30.7	1	7	1	1	14.4	5.6
13. Westcliffe	1.3	1.9	31.5	0	7	2	1	16.1	4.8
14. Santa Rita	0.8	1.5	21.7	1	8	1	*	12.2	6.5
15. Laurel	0.7	2.0	41.4	4	4	2	0	16.8	6.2
16. Evansville	0.4	1.3	4.7	4	3	3	0	3.7	6.4
17. W. Tenn.	1.0	1.9	27.9	4	5	1	*	6.9	5.6
18. Midway	0.7	0.8	33.0	2	2	6	*	6.6	13.3
19. Commercial fuller's earth	1.3	1.6	26.3	3	2	3	2	6.8	10.0
20. Halloysite	1.0	1.4	42.9	0	10	*	0	9.4	14.2
21. Woodward	0.6	1.7	41.0	5	4	1	*	13.1	11.2
22. Saline	0.8	1.6	29.5	3	5	2	0	14.6	6.9
23. Cordele	1.3	1.3	15.1	4	5	1	*	2.0	8.8
24. Musselwhite	0.9	1.8	30.6	5	4	1	*	5.4	8.6
25. Fort Gaines	1.3	1.4	4.5	5	4	1	*	4.3	6.0
26. Chicakamauga	1.0	1.9	20.7	3	5	2	*	2.7	7.2
27. Wyoming Bent.	0.7	1.3	19.7	3	5	2	*	6.3	5.9
28. N. J. Glauconite	1.2	1.5	43.3	9	1	0	0	1.9	5.1
29. Md. Glauconite	1.2	1.7	38.3	10	0	*	*	3.5	5.9
30. Bavarian Bent.	0.7	2.0	21.9	3	4	3	0	11.0	5.5

*Trace.

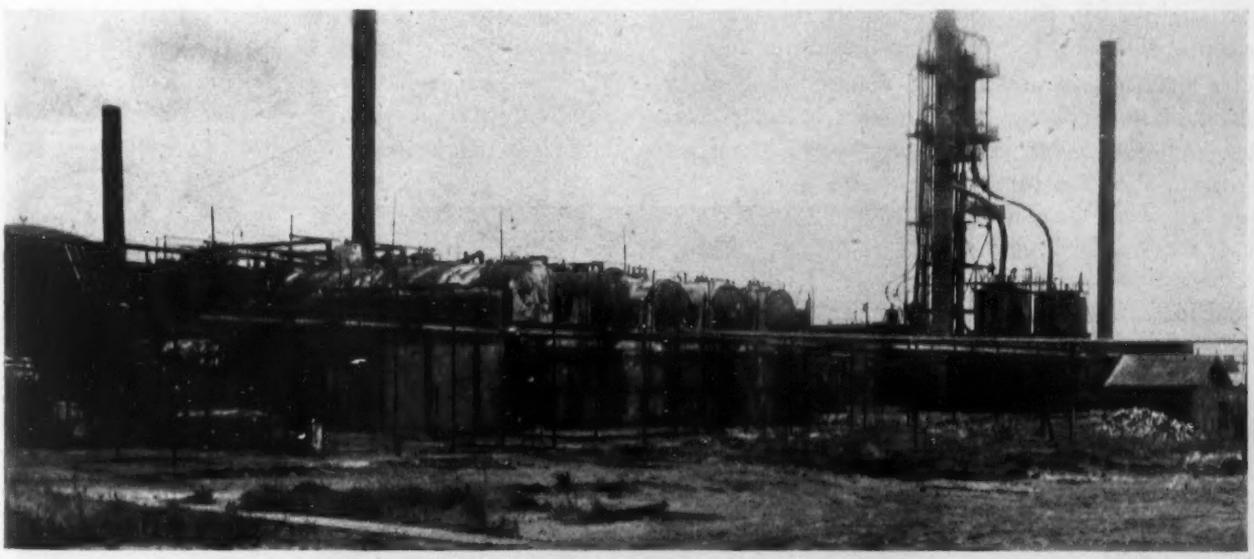
Cracking Installation Adapted to Processing Asphalt

TEXAS Pacific Coal & Oil Company, Ft. Worth, Texas, which owns about half the production in the Robinson Pool, west of Wynnewood, Oklahoma, began processing that heavy asphaltic crude at its Wynnewood plant for road oil products in 1931. This crude has an A. P. I. gravity of around 22.5 degrees, contains a very small amount of gasoline with a comparatively low octane number. After beginning the processing of crude for road oil production, the company revised the process and included in it arrangements for the manufacture of 12 standard grades of asphalt, binders, crack filler, roofing asphalt, etc., as well as the facilities for the manufacture of many grades and specifications not carried in stock, but which are demanded by many customers.

When company chemists demonstrated that the crude available for the plant was a true asphalt crude, admirably adaptable for the manufacture of the various road building materials and asphaltic products, two cracking units which had been operated previously in the reduction of lighter crude oils into gasoline, were revamped especially for the manufacture of these special products. There is no cracking operation in this refinery now of any kind; it is an asphalt plant entirely. Everything in the system of these two units was permitted to remain, with the exception of the dephlegmators and condenser units, in the same relative position as they were when first constructed.

The crude is first processed in preparation for the conversion to road and asphaltic materials by being passed through a pipe still reduction unit. The procedure in this case is more or less conventional, taking off streams of gasoline, kerosene and gas oil. The apparatus consists of a conventional pipe still, flash chamber, fractionating tower and side strippers. Preheater and reboiler in this unit are placed in a horizontal position, mounted upon a brick furnace. Fire may be maintained in this furnace with sufficient intensity to drive out the portions of the product that are not desired in the products coming from this particular piece of apparatus.

After skimming, the hot bottoms from the flash chamber are transferred to the road and asphalt conversion unit, either of which may be operated, or both at the same time. In the converted cracking units the dephlegmators and condensers were cut out of the circuit, bringing the vapor line from the towers through a short horizontal line to the condenser boxes, upon which were mounted Southwestern Engineering Corporation tubular units. The towers were left intact, and



Texas Pacific Coal & Oil Company's Wynnewood, Oklahoma, refinery showing converters and re-vamped cracking unit. This plant, originally built as a straight refinery, now processes for asphalt.

upon charging, they are operated in batch, a sufficient amount of the reduced crude being pumped into them and circulated continuously through the pipe still and tower until the desired product has been manufactured.

To facilitate withdrawal through distillation of the lighter products remaining in the bottoms transferred to the reduction units, and at the same time to perform the process of air oxidization or straight steam distillation and processing, Elliott vacuum jets are placed on the vapor lines leading from the tower in which the material is being circulated. Instead of attaching this jet to the old vapor line leading from the dephlegmators, a straight horizontal piece of connecting pipe leads directly from the upper outlet of the tower across to the old condenser box, the discharge end being connected to a shell and the tube condenser and cooler. If the line had been left in the original condition, leading up through the towers and downwards again, considerable condensation would occur in these connections before the hot vapors and gases could reach the main condenser, thereby back-trapping into the tower those fractions which the process was designed to remove. More time would elapse between the initial firing and the completed material, due to the increased difficulty in removing these lighter fractions. A line connected to this horizontal piece of pipe extends over and beyond the condenser, embodying in it the vacuum jet. No condenser column is provided, the action of the steam jet functioning sufficiently to remove air, steam and vapors from the mass of material in the tower.

VACUUM ON TOWER

Vacuum of from 12 to 24 inches is maintained on the tower in the reduction of the material, depending upon whether steam is admitted in distilling off the lighter fractions, or whether air is used in oxidation. As near as possible, the process is completed in this apparatus, but on special material, further reduction is accomplished in the "reduction stills" or converters, horizontal shells, 10 by 40 feet in dimension.

Two openings in the shell of the tower permit admission of steam or air into the mass. One is on top through the head, and another on the side about midway from the base to the upper rim of the shell. These are two-inch openings to which flanges are welded so that an ordinary nipple of two-inch pipe screws into it. On the outer end of this nipple is a two-inch gate, with the air and steam line connected to it so the volume can be regulated to suit the process. The line leading inside the tower extends to the base, terminating in a spider laid cross-wise in order that the full amount of steam or air injected can pass through the mass of material under process.

Temperature held upon the pipe still transfer line runs from 425° F to 675° F, depending upon the grade desired and also whether air or steam is used for reduction. After sufficient time has elapsed, the grade of product having been arrived at, the gates on the circulation pump manifold are manipulated so that instead of charging back through the pipe still, the material may be drawn from the base of the tower and transferred to the reduction stills.

STILLS FOR STORAGE

These stills were formerly utilized for reduction of the heavy fuel oil bottoms to coke, removing during this process, gas oil to be charged to the cracking stills. Now, they are used for both storage and "convertors." If the material run from the pipe still or vacuum units does not quite meet the specifications required in the order for material to be shipped, it is either air blown or further reduced by steam injection. If blending of one grade with another is necessary one batch slightly lighter or heavier in consistency than the one in the reduction stills may be charged to it and thoroughly mixed to produce the required consistency.

A comparatively small investment was necessary to revamping this plant for road oil and asphalt manufacture. Outside of a small amount of labor and a few pieces of pipe installation of vacuum jets, etc., the investment was not large. The net results of the change over is that there is now in operation a very flexible plant, one through which a variety of products may be manufactured with only a change in the amount of air or steam necessary for reduction, a change in the temperature of the furnace in the reduction pipe still, or the time element necessary to manufacture one product different from another.

The writer is indebted to Dr. E. R. Lederer and T. A. Pomeroy of Texas Pacific Coal & Oil Company for their courtesy in permitting the methods of plant operation to be discussed and presented here.

Drum filling plant at loading dock of the Wynnewood refinery

Need for Construction *Seemingly* Is a Paradox

GEORGE REID

CRUMPLING price structures in late 1932 and early 1933 despite a highly favorable statistical position attained by the industry constitutes one paradox with which the industry is familiar. The necessity for continued construction of modern distillation and cracking facilities, even though apparently greatly overbuilt, is another seeming contradiction. Another, and whether necessary or not, is the continued erection of retail outlets by a large number of companies despite the fact that all agree that the maximum number of stations necessary to service patrons was reached years ago. But with all its complexity of influences the petroleum industry achieved an enviable statistical position and to this writing, continues to maintain it.

The favorable influences or factors have consisted of a well sustained demand for petroleum and its products in 1932 and early 1933 as in the earlier years of the depression; an encouraging holding-up of the market for motor fuel and a striking restriction of crude oil production and refining operations to demand requirements. Such restriction was sufficiently effective that both output of crude oil and gasoline were held below actual consumption. This made possible a substantial reduction of above-ground stocks of crude and a slight decrease in motor fuel stocks. This reduction of stocks was accomplished not only in spite of a declining demand, but also in the face of an increase in drilling and unprecedented crude oil producing capacity. Thus, despite the fact that 1932 was a year which should have given much encouragement because of a well sustained demand which was bolstered by real affectiveness in adjusting supply to demand, other influences arose to create a crisis, resulting in low prices for crude oil and crumpling prices for refined products, making profitable operation of the industry in any of its three branches exceedingly difficult to achieve. Those influences are legion but the two of primary importance are violations of the various proration laws which have been holding crude oil production within market demand, and evasion of state and federal gasoline taxes, resulting in the appearance of sufficient low price motor fuel to disrupt the market. Corrective measures are now being applied which augur well for the elimination of much of that which is bad for business.

Technical development within the refining industry and technical and economic factors outside of the industry contribute to the current activity in construction of modern distillation and cracking facilities. Cracked gasoline production, for example, has held up remarkably well because of demand for that product. In Table 1 is shown the cracked gasoline production for the last six months of 1932, averaging around 14,000,000 barrels monthly, or about 466,000 barrels per day. Current production of cracked gasoline revealed by American Petroleum Institute figures converted to Bureau of Mines basis indicate continuing production of the cracked product at the same daily rate of around 460,000 barrels. Refiners, believing this production and demand will be maintained, are improving and enlarging their cracking departments, and many companies not heretofore engaged in cracking are installing processes or studying the situation with the view to erecting units.

The preliminary figures of the United States Bureau of Mines covering 1932 as reported in the December, 1932, Monthly Petroleum Statement, No. 102, shows that the total demand for all oils in 1932, including domestic and export, amounted to 936,770,000 barrels. This indicates a drop of 90,830,000 barrels or 8.8 per cent from the 1931 demand. In comparison with the all-time peak demand of 1929, the 1932 figure represents a decline of 166,433,000 barrels, or 15 per cent. Thus, despite the world depression, the petroleum industry of the United States in 1932 retained approximately 85 per cent of its record market of 1929; a remarkable record of sustained demand.

Narrowing down the demand statistics to motor fuel, the chief source of revenue, an even more encouraging situation is seen. The depression had

TABLE 1
Cracking Operations—Last Six Months, 1932

	Barrels Cracking Stock Charged to Stills	Barrels Gasoline Produced by Cracking	Barrels Fuel Oil Produced by Cracking
July	33,807,000	15,205,000	11,375,000
August	34,979,000	14,442,000	11,375,000
September ...	30,776,000	13,540,000	10,795,000
October	31,807,000	14,003,000	10,844,000
November ...	30,959,000	14,240,000	11,026,000
December ...	30,482,000	13,686,000	11,302,000

TABLE 2

Comparative Analyses

(Thousands of barrels of 42 U. S. gallons)	Jan.-Dec. 1932	Jan.-Dec. 1931
Crude Petroleum		
Runs to stills: Domestic	777,696	837,671
Foreign	42,301	46,937
Total	819,997	894,608
Imports	44,688	47,250
Exports	27,393	25,535
Motor Fuel		
Production	399,145	437,735
Imports	8,209	13,621
Exports[1]	35,434	45,716
Stocks[2]	49,671	51,521
Domestic demand	373,770	403,418
Kerosene		
Production	43,836	42,446
Imports	72	11
Exports	10,956	12,712
Stocks	4,974	5,332
Domestic demand	33,310	31,296
Gas Oil and Fuel Oil		
Production	294,287	336,967
Transfers[4]	6,141	([5])
Imports	21,229	24,998
Exports	19,874	29,231
Stocks	129,971	135,856
Domestic demand	307,668	([5])
Lubricants		
Production	22,433	26,704
Imports	11	32
Exports	6,857	8,128
Stocks	8,375	9,485
Domestic demand	16,697	20,068
Wax (thousands of pounds)		
Production	458,920	477,400
Imports	33,256	37,835
Exports	235,323	290,527
Stocks	164,592	171,220
Domestic demand	263,481	276,457
Coke (short tons)		
Production	1,788,800	2,032,000
Stocks	1,330,200	1,511,600
Asphalt (short tons)		
Production	2,409,000	2,976,500
Imports (natural)	20,400	....
Stocks	276,100	301,800
Road Oil		
Production	6,879	5,177
Stocks	564	333
Still Gas		
Production	40,905	38,630
Miscellaneous		
Production	2,568	4,150
Stocks	456	734

[1] Includes benzol—1743 barrels in December, 1932. [2] Stocks of motor fuel in 1932 include terminal and transit stocks. [3] Revised. [4] Includes crude used as fuel and net transfers to fuel oil stocks. [5] Not available

progressed to 1932 before it could stop the regular annual increase in gasoline consumption, and the years 1929, 1930, and 1931 showed succesively high records in demand, continuing the upward trend which had been in progress throughout the automobile era. In 1932 this trend turned backward, but the reaction was not great as requirements dropped back only to the level of 1929. The total demand for motor fuel in 1932, including 35,434,000 barrels exported, was 409,204,000 barrels, or a decrease of 8.9 per cent from the record demand of 1931. Domestic requirements, representing the greater portion of the gasoline demand, aggregated 373,770,000 barrels, which indicates a 7.3 per cent decline from the high record of the previous year. Production in 1932 amounted to 399,145,000 barrels of gasoline (437,735,000 barrels in 1931), imports were 8,209,000 barrels, exports 35,434,000 barrels, and stocks at the end of the year were 49,671,000 barrels. Stocks declined 1,850,000 barrels from the total of 51,521,000 barrels at the end of 1931.

Of the total motor fuel production during 1932, amounting to 399,145,000 barrels, 195,386,000 barrels was derived direct from the crude as straight-run gasoline. This represents a decline in straight-run production of 24,571,000 barrels from the 1931 total production of straight-run gasoline of 219,957,000 barrels.

The decline in cracked gasoline production during 1932 was proportionately less severe and the ratio of cracked gasoline produced to straight-run gasoline produced was slightly higher. During 1932 the industry produced 170,905,000 barrels of cracked gasoline, while in the previous year the total production was 176,437,000 barrels, a decrease of about 6,000,000 barrels production from the cracking departments of the domestic refineries. As the additional cracking facilities now planned or under construction are placed into service, and as the modernization programs involving many cracking units reach completion, it is expected that gasoline yield from the barrel of crude will be increased further and the production of cracked gasoline may ultimately be greater than the production of straight-run. The economic influences responsible for the largely increased cracking capacity of the industry are still at work, and despite lowered demand for motor fuels, the production of cracked gasoline must continue to increase, and for 1933 at least, accompanied by some decrease in crude oil throughput or demand.

The difference in evidence between cracked and straight-run gasoline production and total gasoline production is that of approximately 32,000,000 barrels of natural gasoline and approximately 1,000,000 barrels of benzol. Natural gasoline blended at refineries dropped off over 8,000,000 barrels from 33,974,000 barrels in 1931 to 25,081,000 barrels in 1932. Benzol consumption by the industry was reduced from 1,826,000 barrels in 1931 to 1,144,000 barrels in 1932.

The minor refined products have enjoyed a similarly well sustained demand. As a class the secondary products showed reduced consumption during the past year,

but several of them had larger demand in 1932 than the previous year, these exceptions being kerosene, road oils and some grades of furnace oils. The increased demand for kerosene was the first since 1925. Total kerosene demand was 44,266,000 barrels last year, which represents an increase of six tenths of one per cent as compared with 1931. The figure given includes 10,956,000 barrels of kerosene exported, which is a material decline in exports, but domestic demand showed a substantial increase when total demand was 33,310,000 barrels, or an increase of 6.3 per cent over 1931.

Lubricants showed a relatively poor record for 1932, reflecting the general industrial inactivity. Domestic demand dropped to 16,697,000 barrels as compared to 20,068,000 barrels in 1931. Exports declined to 6,857,000 barrels in 1932 from 8,128,000 barrels in 1931. In the automotive lubricants field reports indicate that the reduction of lubricants prices, the provision of a cheap grade of lubricants at service stations, and the impetuous marketing of good grades of lubricants through chain stores and mail order houses have done little to bolster up sales. In this field the practice of lubricating oil reclamation, improved lubricating oil saving systems on cars, and increased mileage between draining periods as well as the depressed economic conditions, have all contributed to lessening demand for such oils and greases.

STOCKS OF ALL OILS LOWER

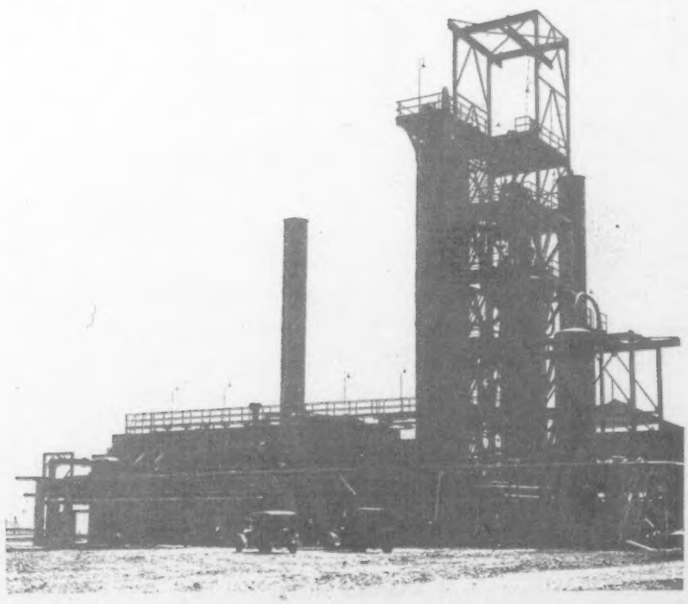
On the supply side as well as on the demand side of the problem the past year was one of success for the petroleum industry, both production of crude oil and manufacture of refined products being curtailed so much as to not only take care of shrinking markets but also to permit the cutting down of stocks.

The total production of crude oil in the United States in 1932, according to the Bureau of Mines preliminary figures, was 781,845,000 barrels, a decrease of 69,236,000 barrels or 8.1 per cent from the 1931 output. For the third consecutive year, therefore, crude oil production has declined from the peak set in 1929 of 1,007,323,000 barrels. The restrictions on production since 1929 have been so effective that output of new crude oil has been held consistently below actual requirements, making possible material reductions in above-ground stocks, with the result that stocks are lower today than they have been since 1928. Total stocks of refinable crude oil declined 32,201,000 barrels in 1932, decreasing to 338,718,000 barrels.

The drafts on stocks were not confined to crude oil for the net decline in stocks of all oils for 1932 amounted to 43,564,000 barrels, leaving on hand December 31, total supply of all oils of 588,172,000 barrels. There were drafts on stocks in eight of the 12 months of the past year. Stocks of motor fuel at the end of 1932 totaled 49,671,000 barrels, as compared with 47,152,000 barrels at the end of November, and 51,521,000 barrels at the beginning of 1932. This reduction of nearly 2,000,000 barrels made in gasoline stocks was achieved in spite of the fact that the percentage yield of motor fuel continued to increase and amounted to 44.7 per cent in 1932 as compared to a yield of 44.3 per cent in 1931.

Among the secondary refined products there were important reductions in stocks. Kerosene stocks were reduced 6.7 per cent during the year, leaving 4,974,000 barrels in storage December 31, 1932. Lubricants stocks were reduced from 9,485,000 barrels to 8,375,000 barrels. Gas oil and fuel oil stocks were reduced from 135,856,000 barrels to 129,971,000 barrels. Wax stocks fell from 171,220,000 pounds to 164,592,000 pounds. Coke stocks were reduced from 1,511,600 short tons to 1,330,200 short tons. Asphalt stocks declined from 301,800 short tons to 276,100 short tons.

The 8.1 per cent decrease in crude oil production during 1932 as compared to the previous year was achieved in spite of a marked increase in drilling. Total oil wells completed in the United States in 1932 number 10,444, as compared to 6788 in 1931.



Utility of Graphical Charts in Design and Operation

C. M. JOHNSON
Consulting Petroleum Engineer,
Houston, Texas

CRACKING plant operations are today perhaps the most carefully watched operation about the modern refineries as the slightest variation in feed, either raw or recycle stock, has a material effect upon the production of desired quantity and quality of product.

A prominent Gulf Coast refinery operating Holmes-Manley cracking units installed hot oil pumps of the twin simplex type, size 22-inch diameter steam cylinders 9½-inch fluid cylinders and 24-inch stroke.

These pumps were rated at 85 per cent volumetric efficiency, 400 gallons per minute hot volume at 400 pounds differential pressure when supplied with steam at 115 pounds per square inch exhausting against 15 pounds back pressure.

In an effort to check rating as well as to control operating conditions, charts were constructed to give the controllmen instant capacities at varying pump strokes.

Chart No. 1 was first constructed giving readings of pump capacity in barrels per hour against strokes per minute at various pump efficiency.

This chart was soon displaced as it did not take into account varying diameter of plungers and Chart No. 2 was constructed with readings in barrels per hour and gallons per minute plotted against plunger

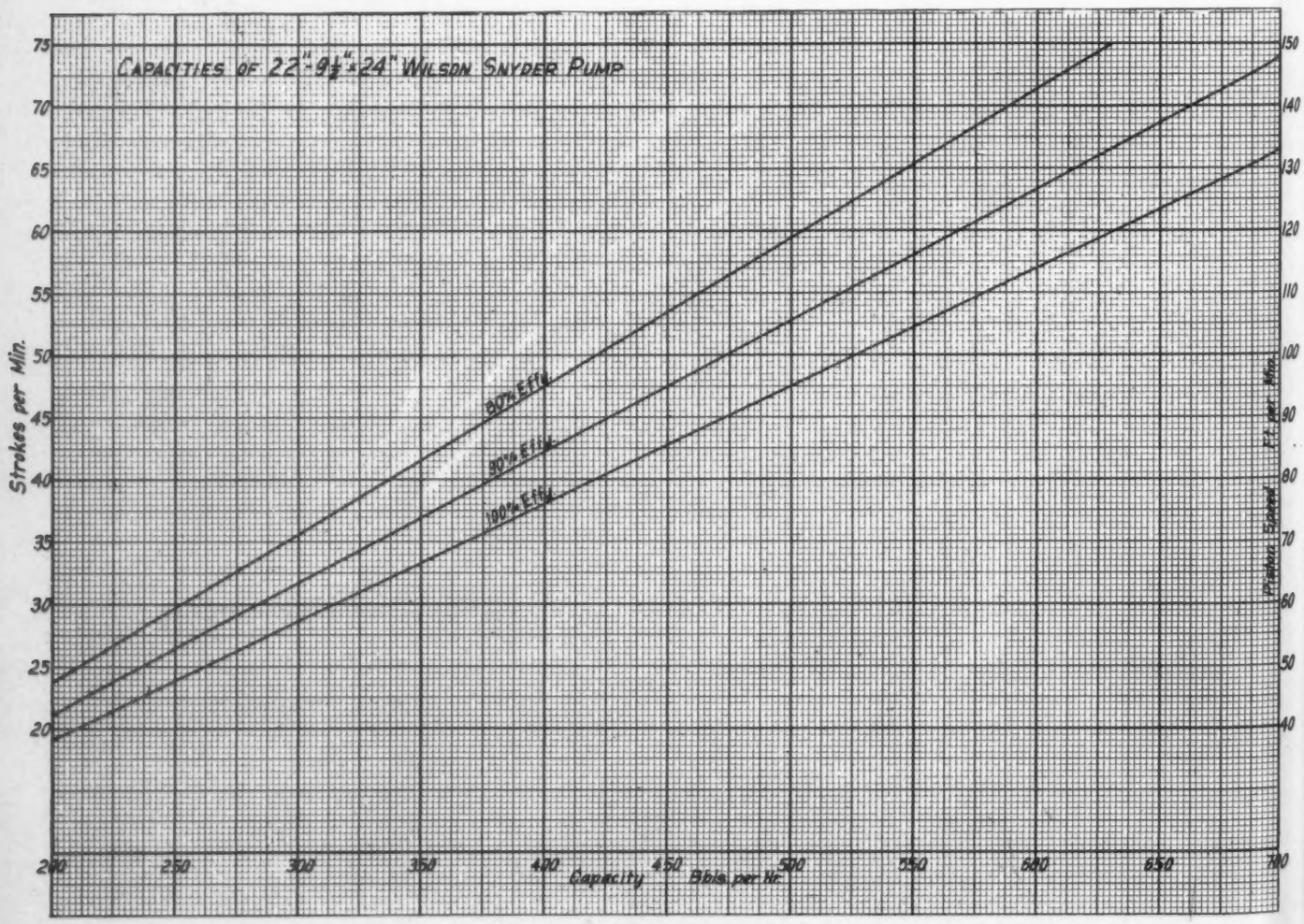


CHART NO. 1

PART 2

THIS is Part 2 of the series of articles dealing with calculating charts or nomographs and their practical application in refinery work. In the previous article the work dealt with the nomograph as a handy tool in making thermo-dynamical calculation as applied to heat transfer apparatus. In the present article, Mr. Johnson discusses the application of calculating charts to refinery operation problems.

strokes and varying diameter plungers. (The plungers were originally 9½ inches in diameter but as time went on these plungers were ground down to smaller diameters in order to be oil tight at the operating pressure and temperature carried.)

Later it was found that the pumps had a tendency to short strokes which of course introduced another variable into the picture and Chart No. 3 was constructed which gave readings in barrels per stroke for varying diameter plungers at varying length of stroke.

To determine what his pump was doing the operator simply had to count pump strokes and measure the length of stroke in inches (the pumps were fitted with stroke counters and a suitable scale to measure the length of stroke so that this part of the operation was simple) and knowing the proper diameter of plunger a factor was secured from the chart reading in barrels per hour per stroke. A quick multiplication of this factor times strokes per minute gave pump rating in barrels per hour at 100 per cent efficiency. Checked against flow meter readings this gave pump volumetric efficiency.

It was soon found that these ratings were often misleading when discussing plant unit operation with others outside the organization and Chart No. 4 was then constructed for a dual purpose; first to reduce all volume readings back to 60°F. and secondly to ascertain the velocity of flow within the heating tubes either at hot or cold volume.

As an illustration, assume that pump plungers are 9¼ inches in diameter; stroke at 22 inches, the factor here from Chart No. 3 being 9.15 barrels per hour. With the pump running 50 strokes or plunger displacements per minute, the capacity computes 9.15 times 50 or 457.5 barrels per hour hot volume. Now assuming a flow

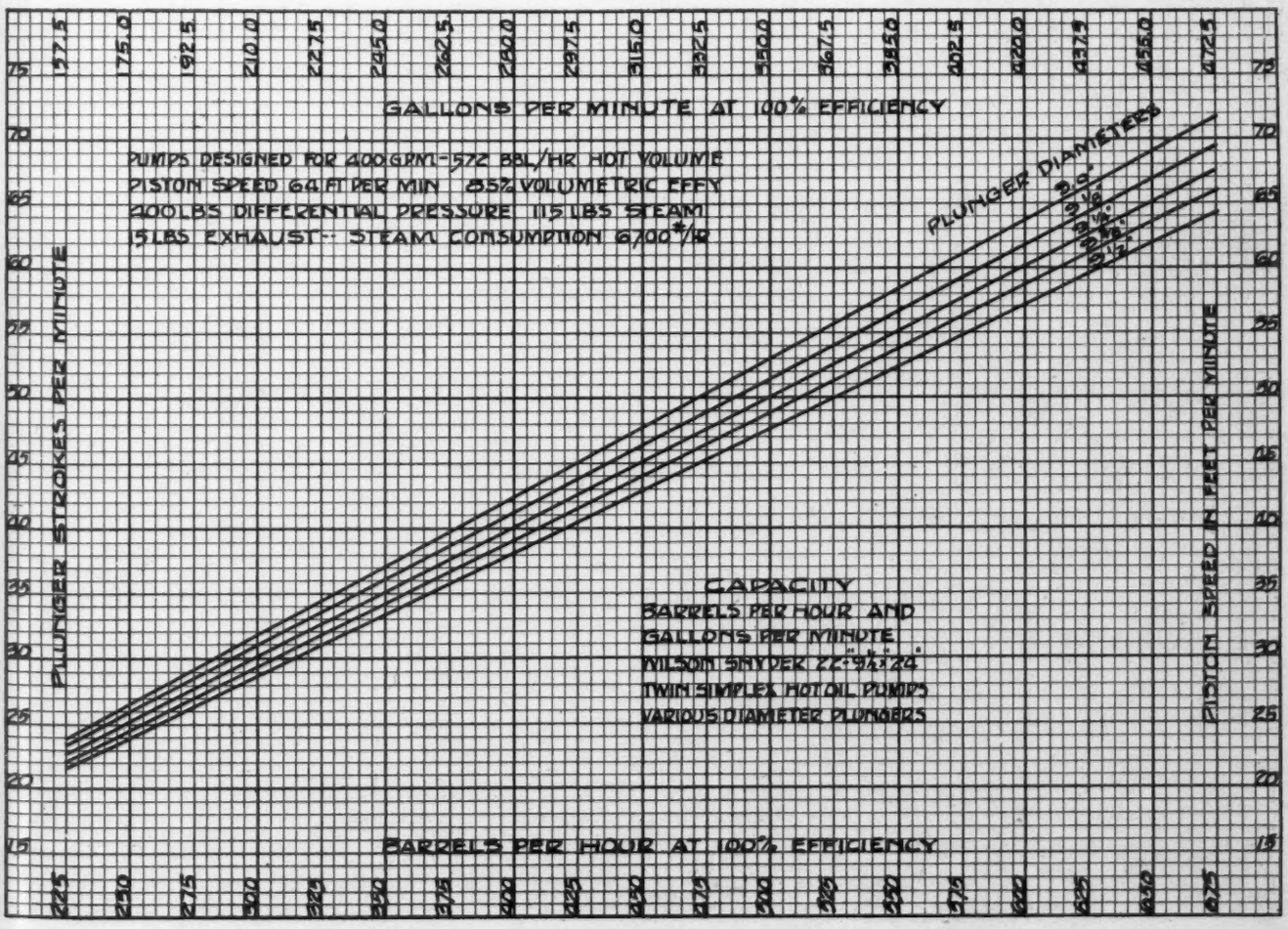

GALLONS PER MINUTE AT 100% EFFICIENCY
PUMPS DESIGNED FOR 400 GPM - 572 BBL/HR HOT VOLUME
PISTON SPEED 64 FT PER MIN 85% VOLUMETRIC EFFY
200 LBS DIFFERENTIAL PRESSURE 115 LBS STEAM
15 LBS EXHAUST - STEAM CONSUMPTION 6700 #/HR
PLUNGER DIAMETERS
PLUNGER STROKES PER MINUTE
PISTON SPEED IN FEET PER MINUTE
CAPACITY
BARRELS PER HOUR AND
GALLONS PER MINUTE
WILSON SNYDER 22"-9½"-24"
TWIN SIMPLEX HOT OIL PUMPS
VARIOUS DIAMETER PLUNGERS
BARRELS PER HOUR AT 100% EFFICIENCY

CHART NO. 2

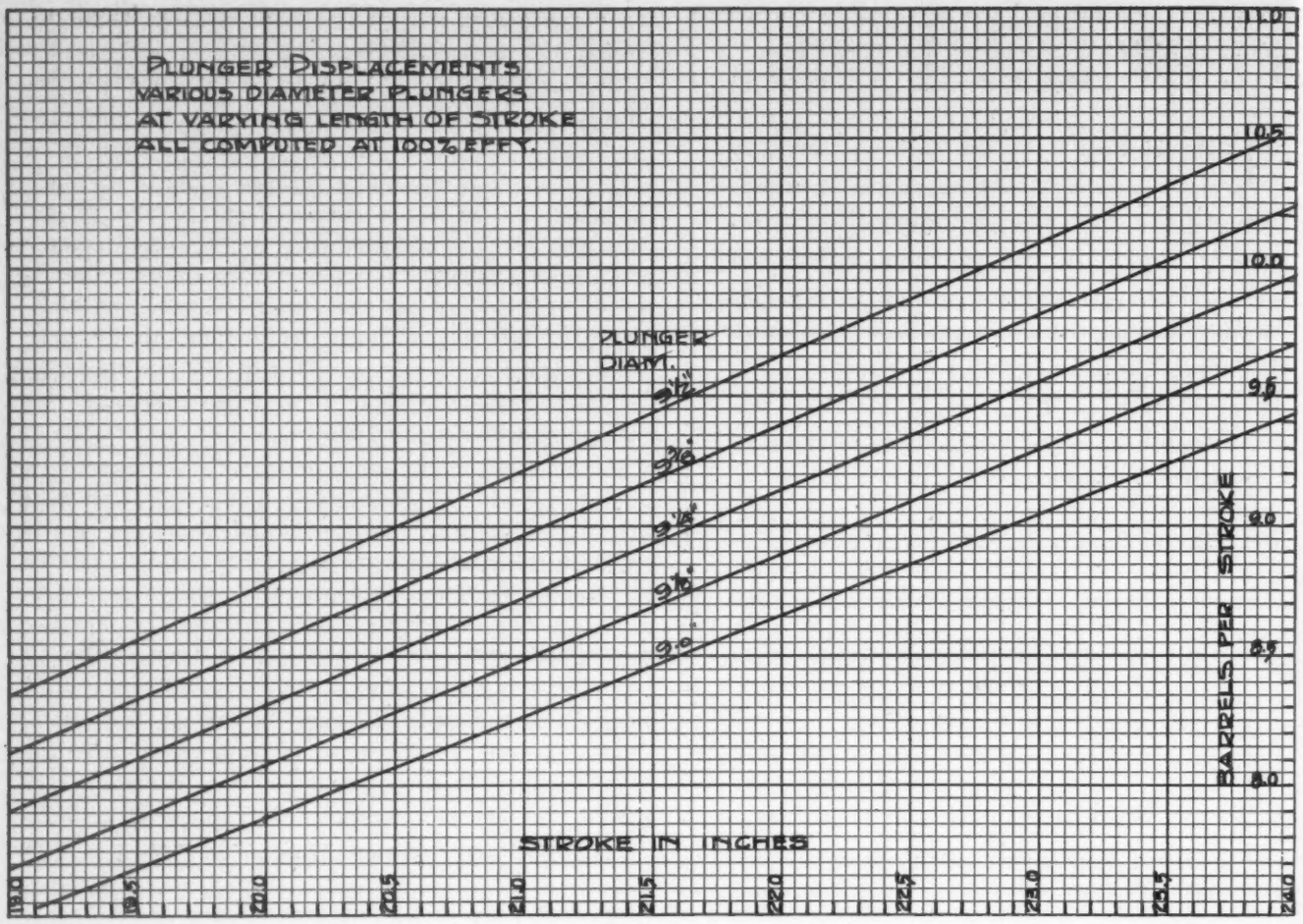


CHART NO. 3

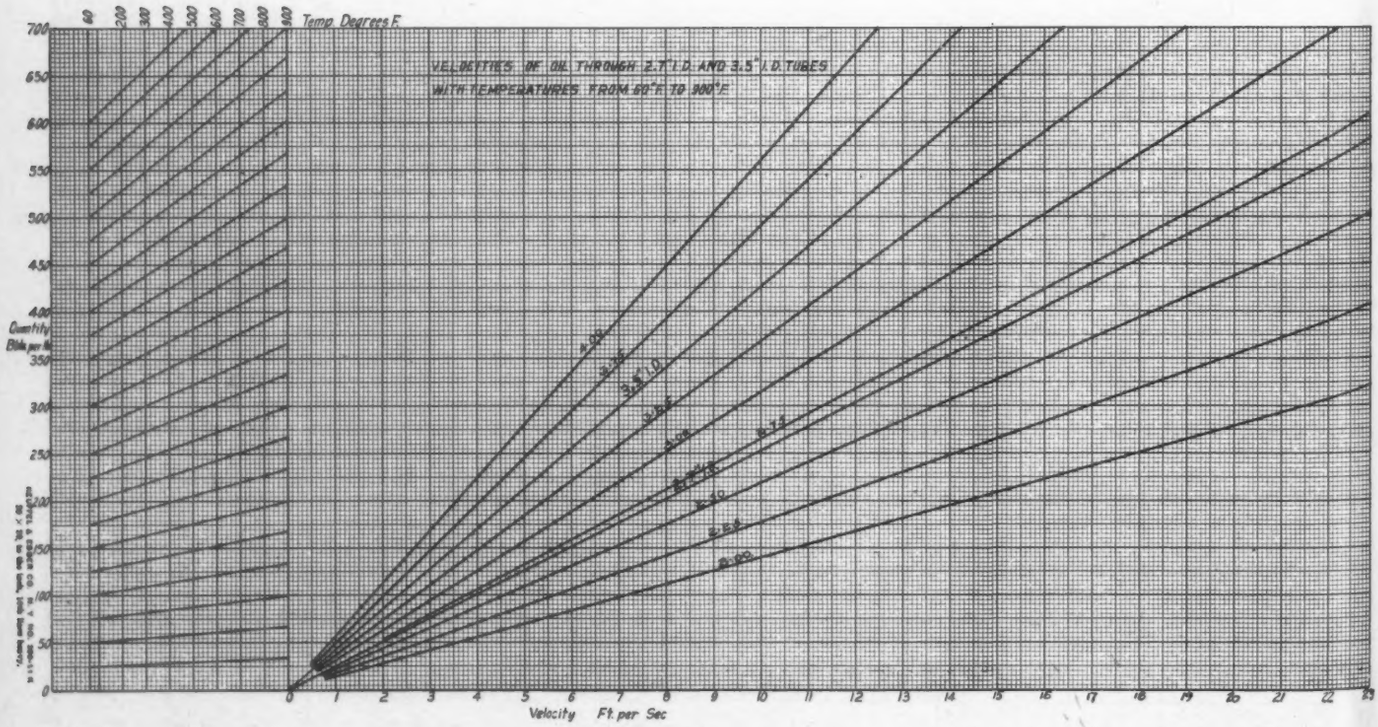


CHART NO. 4

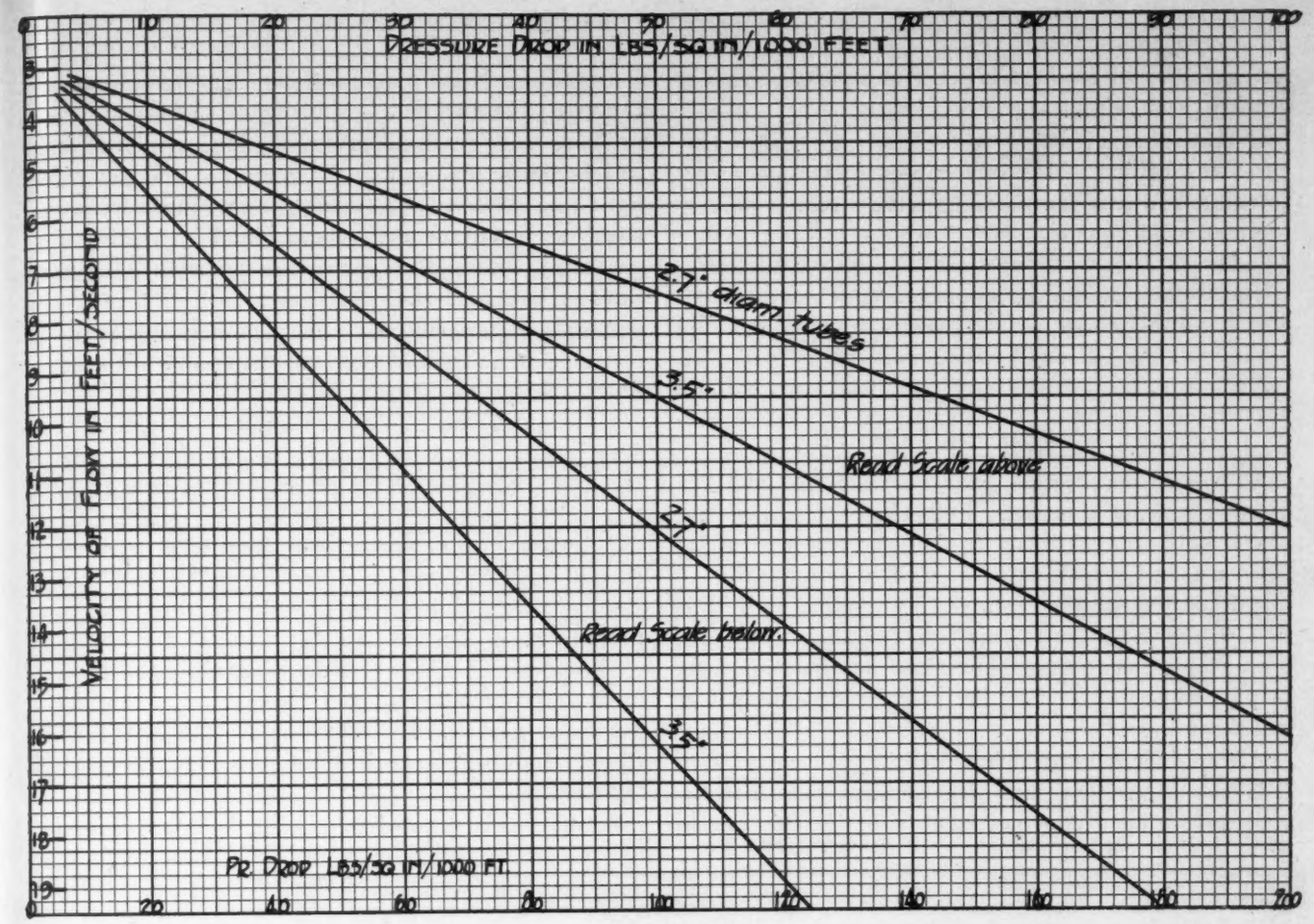


CHART NO. 5

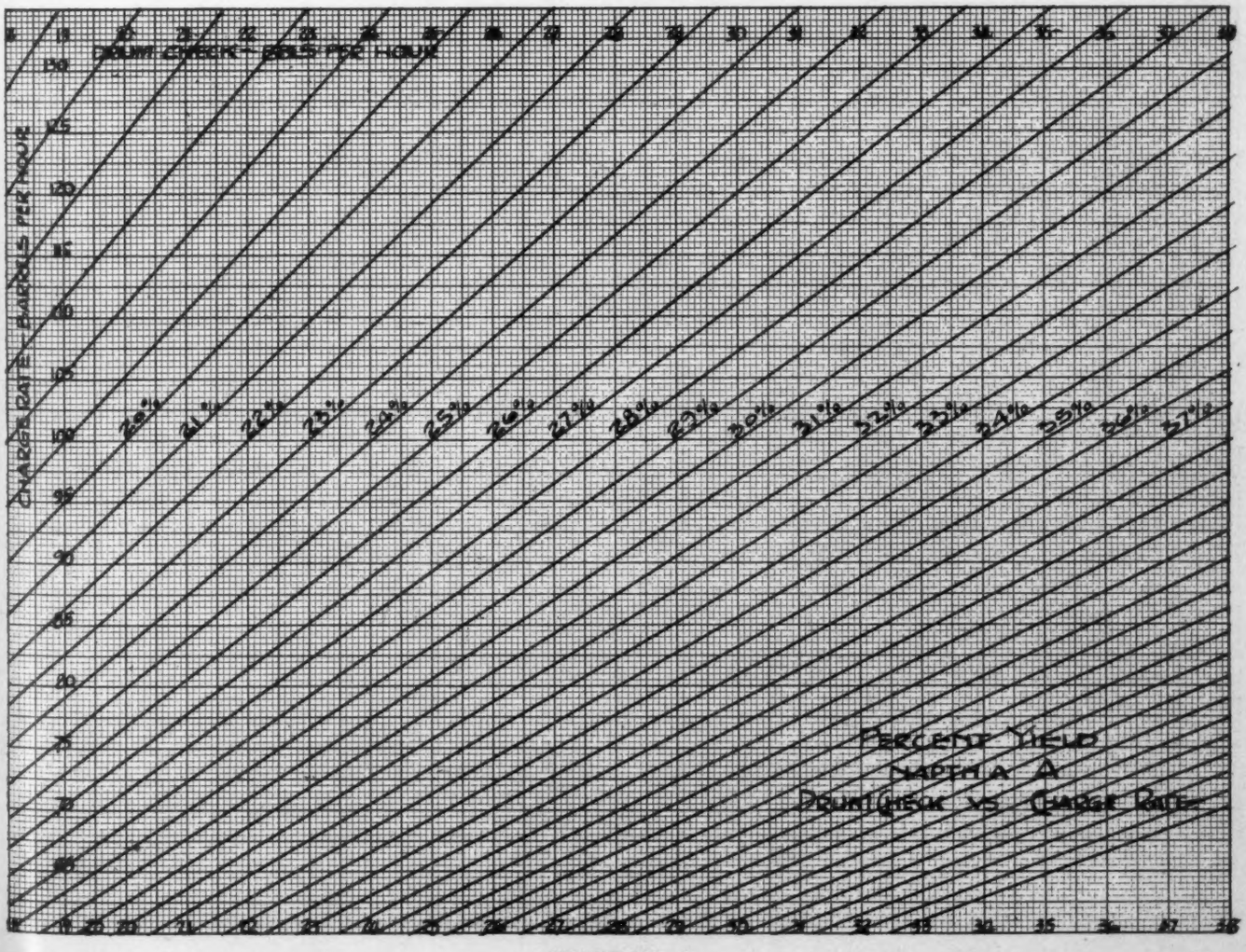


CHART NO. 6

meter reading of 366 barrels per hour a pump efficiency of 80 per cent is found.

In a further effort to secure more accurate capacities the orifice plates in the flow meters were recalculated so that the readings were direct in barrels per hour cold volume. Now referring to Chart No. 4 and the 457.5 barrels per hour hot volume above referred to, and assuming an operating temperature of 800°F. a cold volume of 350 barrels per hour is found by following back on the diagonal line from the intersection of the 800-degree temperature vertical and 457-barrel horizontal ordinates to the 60-degree vertical ordinate.

Tubes in the heating element were 2.7 and 3.5 inches in inside diameter. Following across the 350-barrel horizontal ordinate to the 3.5 and 2.7 diagonal lines we find velocities of flow, cold volume, of 8.2 and 13.85 feet per second.

A further addition to this series of charts was No. 5 which predicts the pressure drop per thousand feet of pipe after first finding the velocity of flow in feet per second.

All engineers know what an involved calculation it is to compute pressure drop and many mechanical charts have been constructed to simplify this operation. Chart No. 5 was worked out from Walker-Lewis and McAdams formulae.

There are an infinite number of combinations which can be made to simplify routine plant calculations and to give the management immediate answers as often the delay occasioned in making the necessary computation will defer decision with possible serious results.

As a final example of how a nomograph may be constructed to benefit both operator and office man Charts Nos. 6 and 7 are offered.

How often has the superintendent or plant manager walked down the battery of stills for a general "look see" arriving at the control house to look over the written records. He sees for example, a charge rate in one column and a production rate in another. Immediately his mind begins to wonder "how much yield are we getting from this charge rate" and that thought calls for a bit of figuring. Chart No. 6 is plotted drum check or production against charge rate in barrels per hour to read the per cent yield from the diagonal line. This chart under the glass in the control room gives an instant answer to the mental question.

Number 7 is somewhat more elaborate to give in-

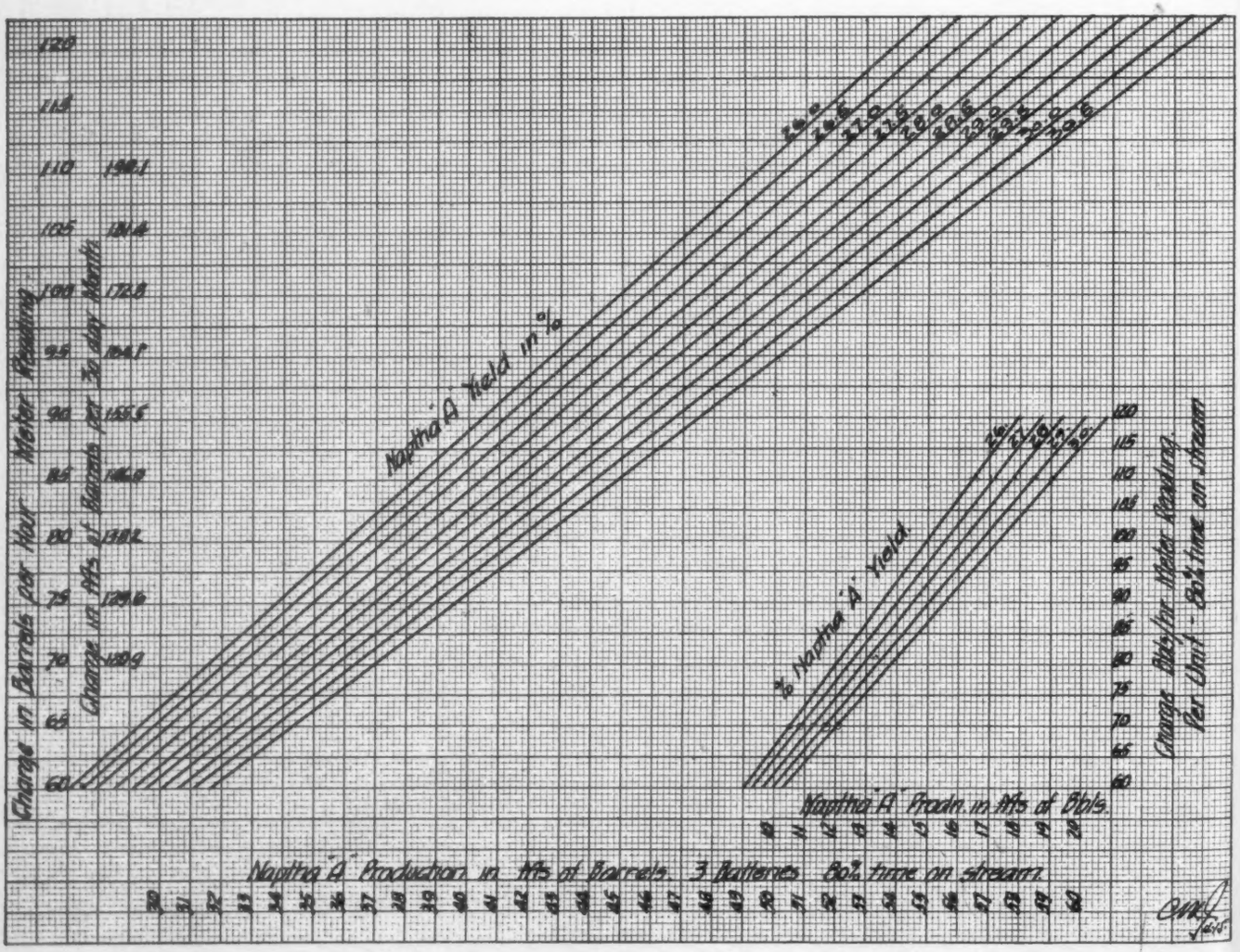

Charge in Barrels per Hour Meter Reading
Charge in Bbls. all Towers for any Month
Naptha "A" Yield in %
% Naptha "A" Yield
Naptha "A" Prodn. in Hds of Bbls.
Naptha "A" Production in Hds of Barrels 3 Batteries 80% time on stream
Charge Meter Reading per Unit 80% time on stream

CHART NO. 7

formation to the budget clerk and superintendent. Suppose there are three cracking units operating at 80 per cent of time on stream. The management sends down instructions to process 172,800 barrels for the month. Previous experience has shown that the stock to be processed will yield 28.5 per cent. Now referring to the chart there appears 172.8 on a horizontal ordinate opposite to 100 which reading means that each unit will have to charge at a rate of 100 barrels per hour for time on stream. Continuing across the 100—172.8 horizontal ordinate to the 28.5 per cent diagonal and dropping to the lower scale on the vertical intersecting ordinate, a reading of 42,900 barrels per month is found as being the production.

This chart also works backwards to give the manager a progress report on processing to check daily yields against throughput to see if operation is living up to budget requirements.

The Construction of Graphical Charts

A. B. STEEN

REFERRING to C. M. Johnson's article, "Utility of Graphical Charts in Design and Operation," appearing in the February, 1933, issue of the The Refiner, page 62, it seems desirable to show the mathematics of construction generally used for charts of this nature, and to assist the reader in the preparation of similar charts.

For this purpose the writer will show the construction of a chart representing the specific heat of petroleum oils at various temperatures.

The United States Department of Commerce, Bureau of Standards Bulletin No. 97, "Thermal Properties of Petroleum Products" gives the equation

$$c = \frac{1}{\sqrt{d}}(0.388 + 0.00045t) \qquad (1)$$

in which c = specific heat, B.t.u./lb./Deg. F., d = specific gravity, t = temp., Deg. F., all of which is incorporated in the following discussion.

The usual form of chart, and probably the easiest to construct is the rectangular, represented by Chart No. 1, in which the specific heat of oil of various gravities is plotted against temperature. It is obvious that the diagonal lines plotted as A. P. I. gravities could just as well be plotted as specific gravities.

In the rectangular chart the temperature is plotted on a horizontal scale, the specific heat on a vertical scale, and the diagonal lines representing the various A. P. I. gravity oils under consideration. To read this form of chart (assuming a 30° A. P. I. gravity oil at 500°F.) enter the bottom at temperature of 500 degrees going vertically to the 30 degrees gravity diagonal, then horizontally from the intersection to the left column, reading the desired value of 0.65. The disadvantage of this form of chart is that it is difficult to interpolate between the lines for intermediate values.

The alignment chart avoids this objection as each variable is represented by a line. To read this form of chart all that is necessary is to lay a straight edge across the two known factors, reading the desired value at the point of intersection.

The mathematics for the construction of an alignment chart is as follows:

If the equation is of the form

$$ax + by = cz$$

where x, y and z are variables, while a, b and c are constants, the three lines are parallel.

An equation of the form

$$axy = cz$$

can be expressed as

$$\log ax + \log y = \log cz$$

so that by plotting the logarithms of the quantities, the parallel form of the chart can be preserved.

The equation

$$axy = cz$$

can be plotted directly by making the x and y lines parallel, and both intersecting the z line.

An equation of the form

$$x^y = z$$

can be expressed as

$$y \log x = \log z$$

so that it can be plotted likewise. The construction of a parallel chart is illustrated by Chart No. 2.

The equation

$$c = \frac{1}{\sqrt{d}}(0.388 + 0.00045t) \qquad (1)$$

can be written

$$c\sqrt{d} = (0.388 + 0.00045t)$$

$$\log c + \log\sqrt{d} = \log(0.388 + 0.00045t)$$

Plot log (0.388 + 0.00045t) on the left axis. The limits

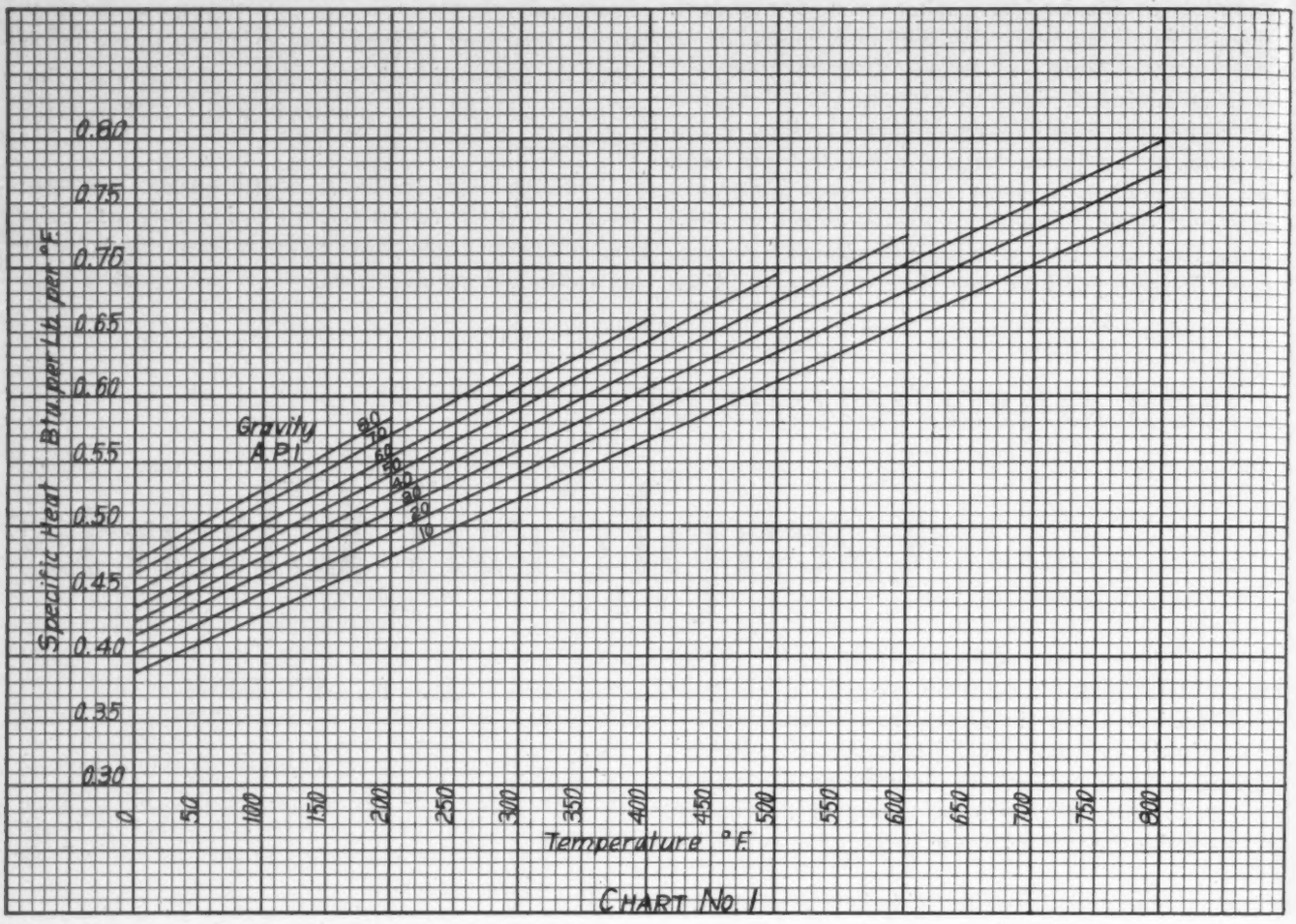


CHART No. 1

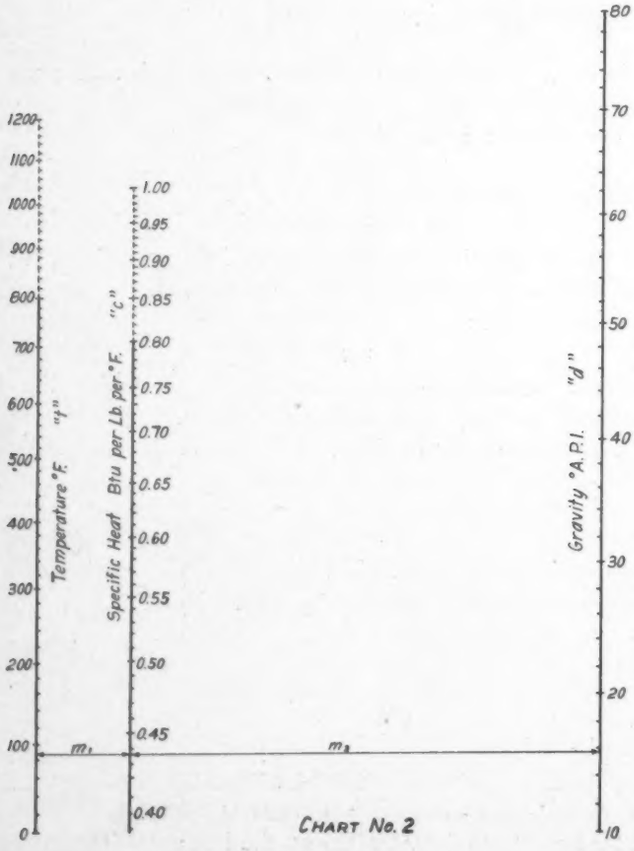


CHART No. 2

of "t" may be taken from 0 degrees to 800 degrees. This makes the quantity to be plotted vary from 0.388 to 0.748.

$$\log 0.388 = 0.5888 - 1$$
$$\log 0.748 = 0.8739 - 1$$
$$0.8739 - 0.5888 = 0.2851$$

The difference is the number to be plotted. Taking a convenient scale,

$$1 \text{ in.} = 20 \log (0.388 + 0.00045t)$$
$$0.2851 \times 20 = 5.702 \text{ in.} = \text{length of the "t" scale.}$$

An intermediate point such as 100 degrees can be found as follows:

$$\log 0.433 = 0.6365 - 1$$
$$0.6365 - 0.5888 = 0.0477$$
$$0.0477 \times 20 = 0.954 \text{ in.} = \text{length from 0 to 100 degrees.}$$

Similarly other intermediate points, say 20-degree intervals can be found.

Plot log $\sqrt{d}$ on the right axis, any convenient distance, say six inches, from the left axis on the same base line.

The specific gravity limits of "d" are 1.000 and 0.669, corresponding to 10 and 80 degrees A. P. I.

The limits of $\sqrt{d}$ are 1.000 and 0.818.

$$\log 1.000 = 0$$
$$\log 0.818 = 0.9128 - 1$$

The difference is 0.0872. A convenient scale is 1 in. = 100 log $\sqrt{d}$

$0.0872 \times 100 = 8.72$ in. = length of the "d" scale.

Intermediate points may be taken at two degree intervals and calculated similarly.

The "c" axis can now be located, and the scale found.

Let m_1 = distance "t" axis to "c" axis

m_2 = distance "d" axis to "c" axis

$m_1 + m_2 = 6$ in.

$\frac{m_2}{m_1} = \frac{100}{20} = 5$ (the 100 and 20 factors being the chosen scales)

Therefore

$m_1 = 1$ in., $m_2 = 5$ in.

The scale for the "c" axis equals the product of the "t" and "d" scales divided by the sum of the "t" and "d" scales.

$$\frac{100 \times 20}{100 + 20} = 16.67$$

The scale of the "c" axis is 1 in. = 16.67 log "c." The equation (1) shows that when t=0 and d=1, c=0.388. The upper limit of the "c" scale may be 0.800, since the highest temperatures and the highest gravities could hardly occur together in practice.

$\log 0.800 = 0.9031 - 1$

$\log 0.388 = 0.5888 - 1$

$0.9031 - 0.5888 = 0.3143$

$0.3143 \times 16.67 = 5.24$ in. = length of the "c" scale.

Intermediate points may be found at 0.01 intervals.

Although the government publication does not take into account temperatures above 800°F., the writer has computed Chart No. 2 from equation (1) to 1200°F.

It is interesting to note the differences by various authorities in the published data on specific heat of petroleum oil, the formulae showing wide variation in form as follows:

(A) Bureau of Standards

$$c = \frac{1}{\sqrt{d}}(0.388 + 0.00045t)$$

(B) Fortsch and Whitman, Industrial and Engineering Chemistry, Vol. 18, No. 8

$$c = \frac{(670 + t)\ (2.1 - d)}{2030}$$

(C) Eckhart, Mechanical Engineering, Vol. 47, No. 7

$$c = \frac{460 + t}{520}(0.7125 - 0.3105d)$$

The differences between the formulas for specific heats by the various authorities are shown graphically by Chart No. 3.

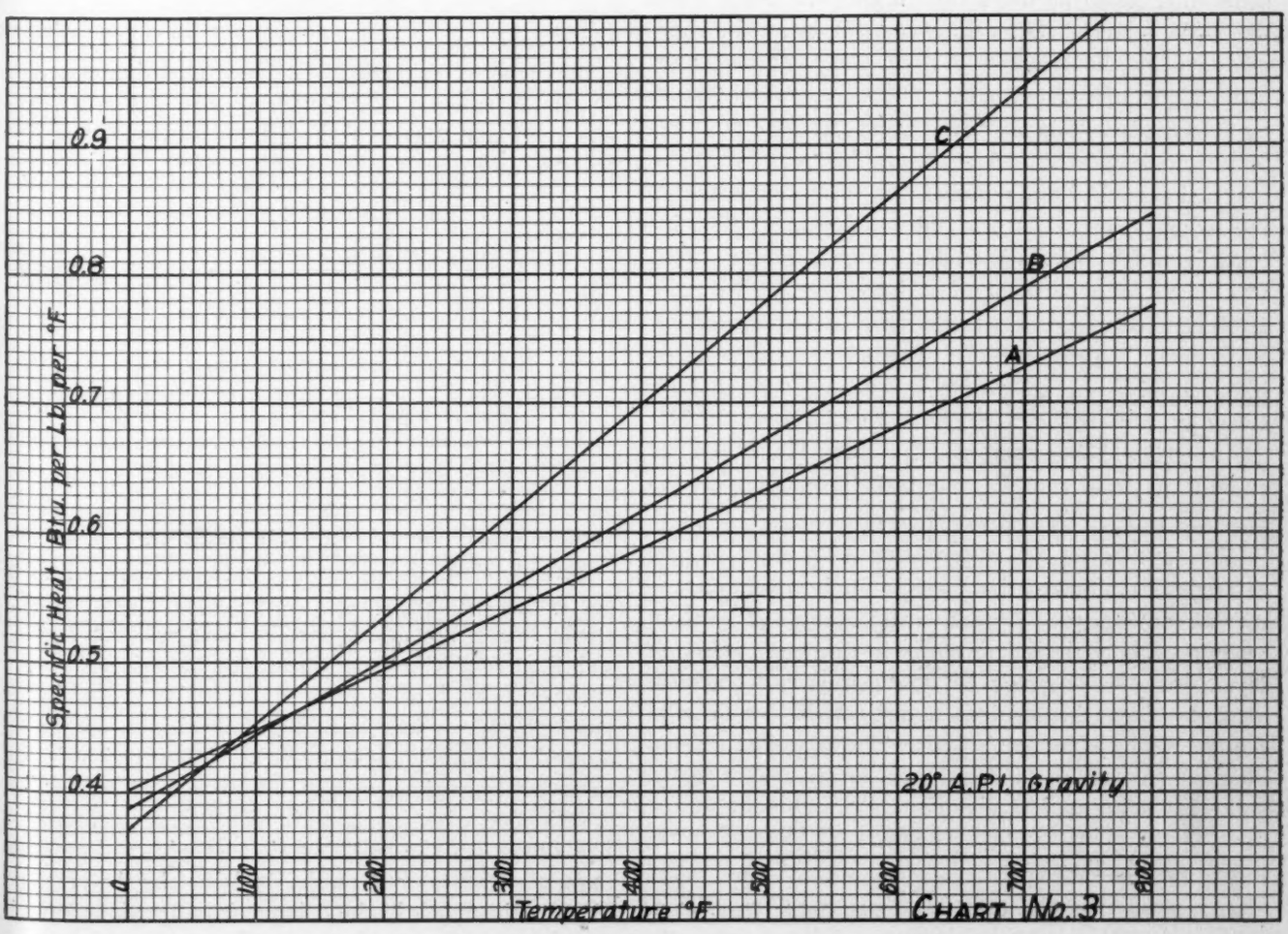


CHART No. 3

Preparation of Ethyl Alcohol *from* Ethylene

V. GERR, O. PIPIK and E. MEZHEBOVSKAYA

From Azerbaidzhanskoe Neftyanoe Khozyaistvo: 1932, No. 2, 15-21.

THIS is Part 2 of a series of two articles presenting information dealing with the preparation of ethyl alcohol from petroleum gases both in the laboratory and on a semi-commercial scale. Ethylene was separated from the homologs by making use of the selective absorption ability of activated charcoal, and separated in the form of ethyl sulphuric acid and the alcohol separated by hydrolysys. Silver and iron catalysts were used to accelerate the reaction. The constants of the synthetic alcohol coincide with those of fermentation alcohol.

Translation is by A. A. Boehtlingk.

BEFORE carrying out quantitative experiments the problem of changing from a glass apparatus to one made from other material of greater strength was considered. Lead lined apparatus, ordinarily used in work with sulfuric acid, proved to be of no use in this particular case, because lead precipitates the silver from the solution, thus eliminating the catalyst from the zone of reaction. Experiments with an iron apparatus however gave good results.

The iron column used as a scrubber was 80 centimeters long and five centimeters wide and had a volume of 1675 cc. It was insulated on the outside with asbestos and wired with "nickeline" wire for electric heating. A temperatue of 40°C. used in these experiments was regulated with a rheostat. Finely crushed quartz was used as filler in the column. The charcoal adsorber had the same dimensions as the scrubber and was made from the same material. American coconut charcoal, characterized by the strength of its grain, was used. Its activity was first tested before the process was initiated by a method developed by Gerr and Melikov (this report is being printed). A predetermined amount of the charcoal was saturated with gas at a certain velocity and the increase in weight was then determined. The incease in weight recalculated for 100 grams of charcoal was then called per cent of activity. By this test the fresh charcoal thus had an activity of about 20 per cent. After each experiment the charcoal was transferred into special adsorbers where it was regenerated with steam superheated at a temperature of 220 to 250°C., the operation being continued for three hours and the amount of steam used was checked. The activity of the charcoal was checked at certain intervals.[1]

The first series of experiments (80 liters of gas through 100 grams of charcoal) in the iron column was carried out to produce technical alcohol. A certain amount of polymerized products in the form of an oil layer was always produced when preparing technical alcohol. The acid acquired a distinct dark color and formed sludge after hydrolysis. The technical alcohol obtained as a result of these experiments always had a yellowish color and a slightly unpleasant odor and a high boiling point (78.6°C. at 760 mm.) even after repeated rectification.

[1]M. E. Barker, Ind. Eng. Chem. :22, 926-31 (1930); Chem. Abstr. :24, 4903 (1930).

In these experiments, following experimental data by Glund, sulfuric acid containing one per cent silver was used and 300 grams of an acid of 1.84 specific gravity were used for recirculation in the scrubber.

TABLE 2

No. of exper.	Amount of gas in liters	Amount of charcoal in grams	Velocity of gas in liters per hour	Per cent silver	Yield of alcohol in grams	Per cent alcohol on gas
1	300	375	40	1	39	13
2	300	375	40	1	41	13.6
3	300	375	40	1	41	13.6
4	300	375	40	1	40	13.6
5	300	375	40	1	42.6	14.4

Attempts in using smaller amounts of catalyst were made after a more or less steady yield was attained. Table 3 shows the effect of this procedure.

After having carried out a few experiments with one per cent silver an attempt was made to decrease the amount of silver to 0.2 per cent (experiment No. 5) and finally to eliminate the silver entirely as shown in experiments Nos. 6, 7 and 8. Experiment No. 5 gave satisfactory results, but the following experiments showed a steadily decreasing yield. A lower yield is also observed (experiments Nos. 12-16 and 18-23) during a prolonged experiment with only 0.2 per cent silver. The success of the first experiments with a decreasing amount of the catalyst can be explained by the presence of some silver left in the column from previous experi-

TABLE 3

No. of exper.	Amount of gas in liters	Amount of charcoal in grams	Velocity of gas in liters per hour	Per cent silver	Yield of alcohol in grams	Per cent alcohol on gas
1	300	375	40	1	42.6	14.4
2	300	375	40	1	49.7	16.5
3	300	375	60	1	42	14
4	300	375	80	1	41	13.8
5	300	375	40	0	55	18.6
6	300	375	40	0	37	12.6
7	300	375	40	0	31	10.6
8	300	375	40	0	25	8.3
9	300	375	40	0.2	47	15.7
10	300	375	40	0.2	40	13.6
11	300	375	40	1.0	42	13.8
12	300	375	40	0.2	45	14.8
13	300	375	40	0.2	50	16.6
14	300	375	40	0.2	44	14.6
15	300	375	40	0.2	36	12
16	300	375	40	0.2	20	6.7
17	300	375	40	1	40	13.4
18	300	375	40	0.2	45	14.8
19	300	375	40	0.2	55	18.6
20	300	375	40	0.2	30	10
21	300	375	40	0.2	20	6.7
22	300	375	40	0.2	27	9
23	300	375	40	0.2	23	7.7

ments with larger quantities of the catalyst. It is obvious that experiments with larger amounts of silver may be followed by those with smaller amounts and vice versa without affecting the yield of alcohol whereby some silver is saved.

The second series of experiments with the iron column (40 liters of gas through 100 grams of carbon) was carried out with the intention of obtaining pure ethyl alcohol. The amount of acid used remained the same, i.e., 300 grams.

The alcohol obtained on the basis of this calculation was greatly different from the technical alcohol obtained in previous experiments.

Products of polymerization were either entirely absent or they were present only in traces. The aqueous alcohol was colorless transparent and it had a boiling point of 78.2°C. at 760 mm. after the first rectification. Acid remaining after the hydrolysis and the distillation of the aqueous alcohol was transparent and did not contain any sludgy substances.

A series of experiments carried out in accordance with the above program is given in Table 4.

TABLE 4

No. of exper.	Amount of gas in liters	Amount of charcoal in grams	Velocity of gas in liters per hour	Per cent silver	Yield of alcohol in grams	Per cent alcohol on gas
1	240	600	40	1	24.8	10.3
2	240	600	40	1	29.6	12.6
3	240	600	40	1	22.5	9.4
4	360	900	40	1	42.6	11.8
5	360	900	40	1	47	13
6	360	900	40	1	37	10.3
7	360	900	40	1	44	12.2

The maximum amount of gas which can be passed through the same amount of acid (300 grams) was determined in the series of experiments, Table 5.

TABLE 5

No. of exper.	Amount of gas in liters	Amount of charcoal in grams	Velocity of gas in liters per hour	Per cent silver	Yield of alcohol in grams	Per cent alcohol on gas
1	240	600	40	1	24.8	10.3
2	240	600	40	1	29.6	12.6
3	480	1200	40	1	49.5	10.3
4	480	1200	40	1	29.5	10.3
5	480	1200	40	1	48.8	10.1
6	480	1200	40	1	41.0	8.6
7	720	1800	40	1	49.6	6.9
8	720	1800	40	1	50	7

In the first two experiments (Table 5) 240 liters

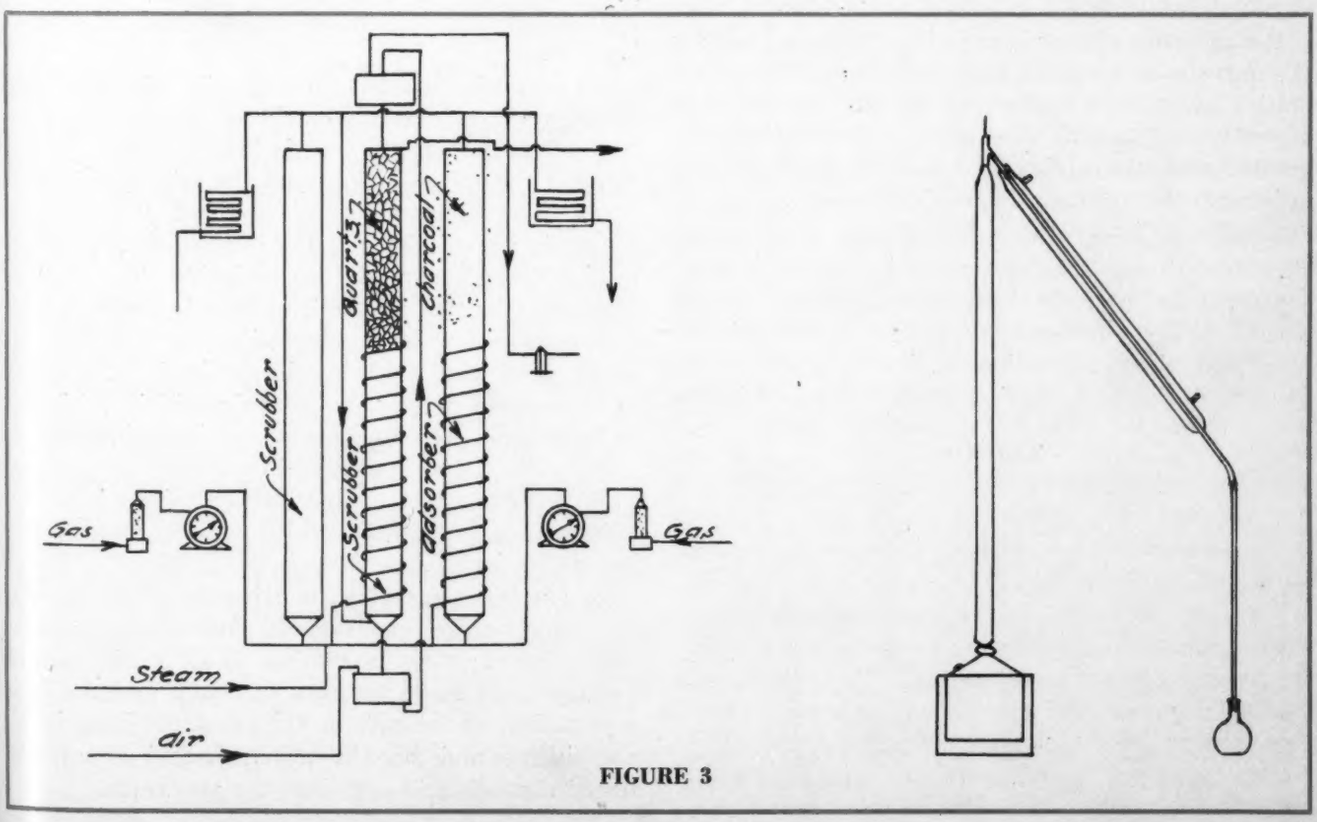


FIGURE 3

gas were passed through 300 grams of acid, while in the following four (3 to 6) the amount of gas passed through the same amount of acid was doubled. The yield of alcohol in grams increased almost proportionally, while yield per cent of alcohol on the gas remained almost constant. On further increasing the amount of gas passed through the acid the percentage of alcohol on the gas decreased on account of the acid losing its efficiency as a result of the reaction and thereby the absorption of gas discontinues. From the experiments it appears advisable to pass 480 liters of gas through 300 grams of acid (160 liters of gas through each 100 grams of sulfuric acid).

The entire series of experiments was, as mentioned above, carried out with silver. Because of the fact that silver is an expensive catalyst it was necessary to develop a method for a maximum recovery of silver. The silver was recovered in two ways: (1) by electrolysis and (2) by precipitation with hydrochloric acid. The electrolysis was carried out in small electrolytic cells with platinum electrodes. Silver was precipitated in the shape of spongy precipitate on the cathode. It is noteworthy that the electrolysis proceeded smoothly if the acid solution was clear after distilling off the alcohol and provided that sludgy substances were absent. In cases, where the acid was not quite pure it was necessary to resort to the chemical precipitation method. A small amount of nitric acid was added to the acid solution containing silver, the solution was then boiled and filtered off from any suspended particles. The filtrate was precipitated with hydrochloric acid and the separated silver chloride was then reduced with zinc to metallic silver in the presence of hydrochloric acid.

It was observed that in experiments carried out for the purpose of obtaining technical alcohol the regeneration was complicated and only small quantities of silver were found in the acid solution, while the greater part was carried off by the sludge and some of it separated on the walls of the scrubber.

When preparing pure ethyl alcohol most of the silver remains in solution and it is therefore easily separated by methods described above. It may be possible that the presence of sludgy substances interferes with the regeneration of silver because of the formation of polymerization products formed in the reaction. In successful experiments for the preparation of pure ethyl alcohol polymerization products are absent and in this case the regeneration of silver proceeds very easily. Table 6 shows experiments confirming this statement.

TABLE 6

Number of experim.	Amt. of gas in liters	Amt. of charcoal in grams	Velocity of gas liter per hr.	per cent silver	Oil layer	Regeneration of silver from solution per cent	Alcohol yield in grams	Alcohol yield in per cent on gas
1	240	600	40	0.2	yes	traces	31.3	13
2	240	600	40	0.2	yes	traces	22.5	9.4
3	240	600	40	0.2	yes	traces	26	10.8
4	240	600	40	1.0	no	90	41	17.2
5	360	900	40	1.0	no	89	42.6	11.8
6	360	900	40	1.0	no	92	47	13
7	360	900	40	1.0	no	96.5	37	10.3
8	360	900	40	1.0	no	87.5	62	17.4
9	360	900	40	1.0	yes	50	41	...

In these experiments an attempt was made to replace the use of the catalyst by operating at a higher temperature. A temperature of 90 to 95°C. was selected, but it caused a more excessive evolution of SO_2 and resinification of the acid.

Because of the technical difficulties met in laboratory experiments it was decided to carry out these experiments on a larger scale. The layout of the apparatus is given in Figure 3.

APPLICATION OF COMMERCIAL MATERIALS

An experimental plant 10 times the capacity of the laboratory apparatus was constructed to check the data obtained on the laboratory scale.

The acid scrubber and the charcoal absorber made from an iron pipe had the same capacity. Their dimensions were: height, two meters; diameter, 10 centimeters, and capacity 15,700 cc. Both columns were heated by steam passed through a coil of one-half-inch outer diameter. This coil was insulated with felt and asbestos. The installation was operated as a commercial apparatus, the adsorber and the scrubber being stationary and the regeneration of the charcoal carried out in place. The same charcoal was used again after regeneration and cooling. The charcoal adsorber held 10 to 11 kilograms of charcoal. The acid scrubber was charged with 25 kilograms of quartz and three kilograms acid were passed countercurrently to the gas.

The operation may be subdivided into the following stages:

(1) Gas is passed through the charcoal and through the acid scrubber. The required temperature, when passing the gas, is held by steam passed through the coil placed around the acid scrubber.

(2) The charcoal is regenerated with steam. Steam is passed through the outer coil and superheated steam is admitted in the inside. The amount of steam admitted in a unit of time is controlled by the amount of water condensation.

(3) The ethyl sulfuric acid obtained as the result of interaction of gas and sulfuric acid is subjected to hydrolysis. The aqueous alcohol is distilled off.

(4) The aqueous alcohol is rectified.

(5) When using a silver catalyst silver is regenerated from the sulfuric acid remaining after distilling of the alcohol.

In a series of experiments using the silver catalyst in a larger scale operation the following procedure was adopted: Gas amounting to 3.5 cubic meters, containing 31 to 33 per cent of heavy hydrocarbons was passed at the rate of 400 liters per hour in all experiments and three kilograms of acid were transferred through acid eggs into the apparatus.

TABLE 7

No. of experim.	cc. of polym-erization products	Regen-eration of silver per cent	Ve-locity of gas, liters per hour	Alcohol yield in grams	B.P. at 760 mm °C.	Alcohol per-cent on gas
5	10	little	6,7	250	78.4	7.2
6	none	77	6.7	370	78.2	10.5
7	none	....	6.7	484	78.2	13.8
8	traces	72	6.7	400	78.3	11.4
9	.....	70	6.7	474	...	13.5
10*	2	little	6.7	534	78.6	15.2
11	none	42.5	6.7	210	78.2	6
12	none	77	6.7	314	...	9
13	traces	60	6.7	340	...	9.8

*After the tenth experiment the column was washed with benzene to remove polymerization products.

The first four experiments are not given because only technical alcohol was obtained on account of poor regeneration of charcoal. The regeneration proceeded satisfactorily beginning with the fifth experiment. The charcoal was regenerated up to 250 to 300°C. whereby about 90 liters of condensed water were collected. Traces of polymerization products were obtained in some experiments as can be seen from the table. The relation between the presence of polymers and the regeneration of silver, which was discussed in the chapter on laboratory experiments, was entirely confirmed in this installation. The admixture of small amounts of polymerization products is not so terrible, since the effect of the presence of polymers is to form sludgy residues, which precipitate with the silver. As a result only traces of silver could be detected in the sulfuric acid; most of it remained in the column and in the sludgy residues on the bottom of the flask from which the extraction of silver was very difficult.

Therefore, as soon as the scrubber became soiled with polymerization products it was washed with benzene with the application of some heat. This washing operation was quite satisfactory but the first experiments show a slightly lowered yield of alcohol and small quantities of regenerated silver. Beginning with the 3-4 experiment after the washing of the column with benzene its performance became more normal and the regeneration of silver reached 77 per cent. The regeneration of silver, as was described in the chapter on laboratory experiments, was carried out by the chemical method because of the lack of an electrolytic container of sufficient size. From an acid high in sludgy substances the greater part of the silver separated in the sludgy residue. This precipitate was easily soluble in nitric acid. It was necessary to boil the spent acid with a small amount of nitric acid to obtain pure silver chloride. The silver present in the precipitate in the bottom of the flask was extracted in a similar manner by boiling it with nitric acid and precipitating with hydrochloric acid. Table 8 illustrates the preceding experiments.

TABLE 8

Number of experim.	Grams silver separated from the solution	Grams silver separated from the precipitate	Total grams of regenerated silver	Per cent of regenerated silver
6	9	13.85	22.85	76
14	17	6	23	77
15	12.75	4.9	17.65	59

In experiment 6 the major part of the silver is separated from the residue because the spent acid contained sludgy substances. In experiments 14 and 15 most of the silver was recovered from the solution because in these experiments the spent acid was clean.

Having in mind the high price of the silver catalyst and the difficulties encountered in its regeneration it was decided to develop a method without the use of silver, even though a lower yield of alcohol would be obtained.

The following series of experiments was carried out without the use of the silver catalyst, using instead a higher temperature, up to 90 to 95°C. By direct experiment it was established that the iron walls of the scrubber have a catalytic action, but of course much lower than that of silver.

Without enumerating the great number of experiments carried out without the catalyst a condensed table is given below which shows the limit for the velocity of the gas flow.

TABLE 9

No. of ex-perim.	Regener-ation of char-coal in °C.	Temper-ature of acid °C.	Velocity of gas in liters per min.	Specific gravity of acid before	Specific gravity of acid after reaction	Alcohol yield in g.	Alcohol yield per cent
10	255	82	8.33	1.844	1.587	243	8.1
11	235	87	10	1.844	1.585	252	8.4
12	255	81	10	1.844	....	256	8.5
13	265	82	12.5	1.844	1.706	237	7.9
14	255	84	12.5	1.844	1.710	229	7.6
15	260	85	17	1.846	1.732	170	5.7
16	300	83	17	1.846	1.733	180	6
17	255	94	17	1.846	....	184	6.1
18	270	74	12.5	1.846	1.721	230	7.7

Thus from the above table it is evident that the most suitable gas velocity is 10 liters per minute. Under these conditions the yield of alcohol amounts to 8.1 per cent of the gas. In the last series of experiments three cubic meters of gas were passed through 10 kilograms of charcoal instead of 3½ kilograms, as was the case in previous experiments. Because of this change in the procedure a perfectly pure alcohol was obtained and polymerization products were absent. The entire aqueous alcohol produced (20 per cent concentration) was fractionated through a Gerl three meter column.

A few examples of the results obtained in the rectification may be cited. The products from experiments 17, 18 and 19 were combined, giving a total of 536 grams of alcohol. Four hundred sixty-eight grams were distilled off at a temperature of 78.4°C. and 764 mm. which after correction, is equivalent to a boiling point of 78.2°C. After the rectification, the strength of the alcohol was generally 92 to 93 per cent. When using 3½ cubic meters of gas pure alcohol was obtained in some cases, however in others

(*Continued on page* 103)

Cost Accounting *and the* Chemical Engineer

A. G. PETERKIN *and*
H. W. JONES*
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BY way of illustration, the principles and mechanism involved in these systems are applied to the operating and sales statistics of an imaginary petroleum refinery, and the results for the month of January set forth in the eight tables appended.

The plant is expected to "crack" 24,400 barrels of crude oil per month, and this single process is assumed to produce from the crude 12,000 barrels of marketable gasoline and tar and gas equivalent to 12,200 barrels of bunker fuel oil. A monthly profit of $7130 is anticipated from the standard figures of cost and sales returns summarized in Table V.

Table VIII, the key statement, comparing the actual with the standard profit, shows failure to meet expectations to the extent of $1305, and the extent to which the three department heads contributed to this result.

The manufacturing manager appears superficially in a favorable light, since by skillful manipulation of his apparatus he has obtained more high priced gasoline and less low priced fuel from the crude oil than was expected, thereby making possible an increase in profit of $1125 had the entire production been sold; he has been able to process crude oil in excess of the standard quantity which should have netted an additional $467, but his operations have been more costly than standard to the tune of $427, leaving him with a net credit of $1165.

The sales manager failed not only to realize the expected market values, which cost the company $900, but also failed to meet his estimate of total sales, so that goods have been held in inventory at cost prices, which, had they been sold, would have shown an additional profit of $2065; the statement shows a total loss charged against him of $2965.

The analysis points directly to low sales volume as the most important cause of failure to meet expectations. Inquiry brings out the following facts: The sales manager based his sales budget on the manufacturing manager's estimate of production, expressing at the same time his disappointment that the plant could not produce more. The plant therefore assuming a ready market bent its energies to increasing throughput, but failed to inform the sales department of its success. The sales manager faced with falling market prices, and assuming that his supply was limited, attempted to hold his prices above the market level, succeeded in obtaining $2.85 per barrel for his gasoline as against an anticipation of $3.00, but could have sold the entire output at $2.80. Had he done so an additional profit of $830 would have been realized. This situation clearly calls for greater cooperation between sales and manufacturing departments, and the latter must share the blame, and assist in correcting the fault.

The falling market is beyond company control and the condition can only be offset by increased production and decreased manufacturing costs. This directs attention to the analysis of manufacturing costs shown in Table IV. Examination of these figures somewhat removes the manufacturing manager's glow of pride, since his economies are largely due to the good fortune of decreased unit costs of raw material, supplies and labor, he actually having used excess steam and other commodities having a value as standard prices of $680 per

*Presented before the meeting of the American Institute of Chemical Engineers, Washington, D. C., December 7-9, 1932.

THIS is Part 2 of a discussion which started on page 58 of The Refiner for February, 1933.

The following list will serve as a ready reference for the meaning of the symbols used in the various tables.

LEGEND

Ca = Actual Total Cost
Cs = Standard Total Cost
ca = Actual Unit Cost
cs = Standard Unit Cost
pa = Actual Unit Price
ps = Standard Unit Price
Qa = Actual Total Quantity
Qs = Standard Total Quantity
qa = Actual Unit Quantity
qs = Standard Unit Quantity
ra = Actual Unit Market Realization Value
ri = Unit Inventory Value
rs = Standard Unit Market Realization Value
Ta = Actual Throughput for Actual Month
Tc = Standard Throughput for Actual Month
Ts = Standard Throughput for Standard Month
Vi = Volume (bbls.) of Product in Inventory
Vs = Volume (bbls.) of Product Actually Sold
Ya = Actual Yield (per cent)
Ys = Standard Yield (per cent)

TABLE I

Standard Costs Varying With Throughput Rate

Item	Standard Unit Quantity/bbl. Crude Processed	Standard Unit Price	Standard Unit Cost/bbl. Crude Processed
Symbol	qs	ps	$cs = qs \times ps$
Crude Oil	1.000 bbl.	$1.15/bbl.	$1.150
Labor	.075 man hrs.	.80/man hr.	.060
Steam	30.000 lbs.	.50/M lbs.	.015
Other Manufacturing Expense*	.025 still hrs.	8.00/still hr.	.200
Total Standard Cost Varying with Throughput			$1.425

* It will be understood that the term in Tables I, III, etc.—"Other Manufacturing Expense"—is used for the sake of simplicity to cover the usual individual items of cost, here assumed all to vary directly with rate of throughput.

TABLE III

Actual Plant Costs for January

Item	Actual Total Quantity	Actual Unit Price	Actual Total Cost
Symbol	Qa	$pa = \frac{Ca}{Qa}$ (Calculated)	$Ca = Ta \times ca$
Costs Varying Directly with Throughput Rate:			
Crude Oil	26,000 bbls.	$1.10/bbl.	$28,600
Labor	2,100 man hrs.	.75/man hr.	1,575
Steam	800,000 lbs.	.60/M lbs.	480
Other Manufacturing Expense	700 still hrs.	9.00/still hr.	6,300
Total Actual Cost Varying Directly with Throughput Rate			$36,955
Costs Varying Independent of Throughput Rate:			
Supervision	1 man	$350/month	$ 350
Steam	1,300 M. lbs.	.60/M lbs.	780
Depreciation	1 still	3000/month	3,000
Total Actual Costs Varying Independent of Throughput Rate			$ 4,130
Total Actual Cost			$41,085

Actual Crude Throughput in January = Ta = 26,000 bbls.

month. Being urged to greater effort in that direction he turns to his subordinates and requires from them explanation, and where possible, correction of the excess expenditures according to their several responsibilities.

Sufficient has been said to show the usefulness of statements of this kind; the purchasing agent may therefore be commended with no note of criticism for his contribution of $495 in the direction of success.

It will be noted that all computations required for this analysis are made by substitution of actual figures for the symbols in the equations given in the column headings. These equations are formulated once for all by the expert accountants, and their solution is a mechanical operation requiring no reasoning on the part of the clerk preparing the statements.

To facilitate ready understanding of the method of deriving the analytical formulae, the following typical examples are given.

For instance, take the item of labor in Table IV. If

TABLE II

Standard Costs Varying Independent of Throughput Rate

(Unit Costs Are Based Upon a Standard of (30.5 day) Month)

Standard Month $= \frac{365}{12} = 30.5$ days

Item	Standard Total Quantity	Standard Unit Price	Standard Total Cost	Standard Throughput	Standard Unit Cost/bbl. Crude Processed
Symbol	Qs	ps	$Cs = Qs \times ps$	Ts	$cs = \frac{Cs}{Ts}$
Supervision	1 man	$ 350/month	$ 350	24,400 bbls.	$0.01435
Steam	1000 M lbs.	$0.50/M lbs.	500	24,400 bbls.	.02050
Depreciation	1 still	$3000/month	3000	24,400 bbls.	.12295
Total Cost Varying Independent of Throughput Rate					.1578
Total Cost Varying with Throughput Rate (From Table I)					1.4250
Total Standard Unit Cost					$1.5828

Standard Throughput for a Standard Month = Tc = 24,400 bbls. Crude Oil

Standard Throughput for January = $Tc = 24{,}400 \times \frac{31}{30.5} = 24{,}800$ bbls. Crude Oil

TABLE IV

Comparison of Standard With Actual Manufacturing Cost for January

Item	Standard Total Cost for January = Actual Throughput @ Standard Unit Cost	Actual Total Cost for January = Actual Throughput @ Actual Unit Cost	Total Variation Actual from Standard + = Saving — = Loss	Variation Due to Quantities Consumed per Unit of Throughput	Variation Due to Change in Quantites Consumed per Unit of Time	Variation Due to Unit Price Paid for Quantity Consumed	Variation Due to Change in Throughput Rate (Crude Capacity)	Variation Due to January Being a 31-day Month
Symbol	$Ta \times cs$	$Ta \times ca$	$(Ta \times cs) - (Ta \times ca)$	$(Ta \times qs - Qa)ps$	$(Qs - Qa)ps$	$(ps - pa)Qa$	$(Ta - Tc)cs$	$(Tc - Ts)cs$
Costs Varying with Throughput Rate:								
Crude Oil	$29,900	$28,600	+ 1,300	×	×	+ 1,300	×	×
Labor	1,560	1,575	— 15	— 120	×	+ 105	×	×
Steam	390	480	— 90	— 10	×	— 80	×	×
Other Manufacturing Expense	5,200	6,300	— 1,100	— 400	×	— 700	×	×
Total	$37,050	$36,955	+ 95	— 530	×	+ 625	×	×
Costs Independent of Throughput Rate:								
Supervision	$ 373	$ 350	+ 23	×	×	×	+ 17	+ 6
Steam	533	780	— 247	×	— 150	— 130	+ 25	+ 8
Depreciation	3,197	3,000	+ 197	×	×	×	+ 148	+ 49
Total	$ 4,103	$ 4,130	— 27	×	— 150	— 130	+ 190	+ 63
Grand Total Manufacturing Expense:	$41,153	$41,085	+ 68	— 530	— 150	+ 495	+ 190	+ 63

TABLE V

Standard Realization and Profit on Standard Products in a Standard Month (30.5 Days)

(After deducting selling and administrative expense)

Item	Production Volume	Standard Unit Realization or Standard Unit Cost	Standard Total Realization or Standard Total Cost
Symbol	$Ts \times Ys$	rs or cs	$Ts \times Ys \times rs$ or $Ts \times cs$
Realization from Sales: Gasoline (Yield = Ys = 12,200/24,400=50%)	12,200 bbls.	$3.00/bbl.	$36,600
Fuel Oil, etc. (Yield=Ys =12,200/24,400=50%	12,200 "	.75/bbl.	9,150
Total all Products	Ts=24,400 "	×	$45,750
Deduct Estimated (Standard) Mfg. Cost	24,400 "	1.5828 (From Table II)	$38,620
Anticipated Profit for Std. Month (30.5 days)			$7,130

TABLE VI

Actual Realization on Actual Products in January

(After deducting selling and administrative expense)

Item	Production Volume	Actual Unit Realization = ra or Inventory Value = ri	Actual Total Realization
Symbol	$Ta \times Ya$	ra or ri	$Ta \times Ya \times ra$ or $Ta \times Ya \times ri$
Gasoline: Sold	Vs = 10,000 bbls.	$2.85/bbl.	$28,500
Inventory Change	Vi = + 3,500 "	2.42/bbl.	8,470
Total Gasoline Production —bbls. (Yield=Ya= 13,500/26,000=51.92%)	13,500 "	×	$36,970
Fuel Oil: Sold	Vs = 12,000 "	$ .80/bbl.	$ 9,600
Inventory Change	Vi = + 500	.68/bbl.	2,340
Total Fuel Oil Production —bbls. (Yield = Ya = 12,500/26,000=48.08%)	12,500 "	×	$ 9,940
Total all Products	Ta = 26,000 "	×	$46,910

from the actual man hours (Qa) the standard man hours ($Ta \times qs$) are deducted, and the remainder multiplied by the standard price per man hour (ps), the net loss due to using greater than standard man hours is obtained separate and distinct from the effect of any change in unit price.

Similarly, the effect of any change in unit price is separated by multiplying the difference between standard unit price (ps) and actual unit price (pa) by the actual man hours consumed (Qa).

Thus, the two equations necessary to analyze the total difference between actual and standard cost of labor into its two component factors, change in quantity consumed and change in unit price paid, are formulated once for all for the use of the clerical force, as follows:

$$\text{Quantity Variation} = (Ta \times qs - Qa)ps$$
$$\text{Price Variation} = (ps - pa)Qa.$$

Tables I, II, and III contain standard and actual plant data, used to construct—*Table IV*, which is an analysis of variations in manufacturing cost.

Tables V, and VI contain standard and actual sales data used to construct—*Table VII*, which is an analysis of variations in sales return.

Table VIII is the final analysis of profit variation classified by executive responsibility.

The reasons for the company's failure to realize the anticipated profit by $1305 are as follows:

Manufacturing Manager's Responsibility:	Dollars
Improvement in Gasoline—Fuel Oil Yield Ratio	+1125
Standard Market Realization on Products resulting from Increased Crude Capacity	+3000

TABLE VIII

Analysis of Profit After Deducting Selling and Administrative Expense

	Anticipated for Standard Month	Actual for January	Variation + = Saving — = Loss
Total Realization from Sales	$45,750	$46,910	
Deduct Total Manufacturing Cost	38,620	41,085	
Profit	$ 7,130	$ 5,825	— 1305

TABLE VII

Variations of Actual Sales Realizations from Standard

Item	Standard Return = Standard Throughput Rate at Standard Yield Ratio Valued at Standard Market Price	Actual Return = Actual Throughput Rate at Actual Yield Ratio, Valued at Actual Market Price	Total Variation Standard from Actual + = Saving — = Loss	Variation Due to Change in Yield Ratio	Variation Due to Change in Throughput Rate	Variation Due to Change in Market Price of Goods Actually Sold	Variation Due to Selling More or Less Than Actual Production (Inventory Change)
Symbol	$Ts \times Ys \times rs$	$Ta \times Ya \times ra$ or $Ta \times Ya \times ri$	Column No. 1 minus Column No. 2	$Ta(Ya-Ys)rs$	$(Ta - Ts)Ys \times rs$	$(ra - rs)Vs$	$(rs-ri)Vi$
Gasoline: Sold	$36,600	$28,500	— 8,100	×	×	— 1,500	×
Inventory Change	×	+ 8,470	+ 8,470	×	×	×	×
Total Gasoline	$36,600	$36,970	+ 370	+ 1,500	+ 2,400	— 1,500	— 2,030
Fuel Oil: Sold	$ 9,150	$ 9,600	+ 450	×	×	+ 600	×
Inventory Change	×	+ 340	+ 340	×	×	×	×
Total Fuel Oil	$ 9,150	$ 9,940	+ 790	— 375	+ 600	+ 600	— 35
Total all Products	$45,750	$46,910	+ 1,160	+ 1,125	+ 3,000	— 900	— 2,065

		Dollars
Deduct Cost of Increased Crude Capacity at Standard Unit Cost ($41,153—38,620)	—(+2533)	
Net Increase in Profit at Standard Values due to Increased Crude Capacity		+ 467
Manufacturing Savings and Losses over Standard:		
Loss due to Increased Quantities Consumed.....	— 680	
Saving due to Calendar Variation (Jan.=31 days)	+ 63	
Saving (over Standard) due to Increased Crude Capacity	+ 190	— 427
Total Manufacturing Responsibility		+1165
Purchasing Agent's Responsibility:		
Saving due to lower prices paid for labor, materials, and supplies		+ 495
Sales Manager's Responsibility:		
Loss due to Lower Market Price on Goods Actually Sold		— 900
Loss due to not selling entire production (Inventory Change)		—2065
Total Sales Responsibility		—2965
Total Loss in Profit—All Responsibilities Combined		—1305

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Preparation of Ethyl Alcohol From Ethylene

(*Continued from page 99*)

it had admixtures of polymers. In the latter case the alcohol had the odor of SO_2 even after rectification. This odor could be disposed of when treating the aqueous alcohol with lime.

For the purpose of comparing the constants of the synthetic alcohol with those of fermentation alcohol, both were converted into absolute alcohol by the action of anhydrous lime after distillation under identical conditions. The constants of absolute alcohols are in the table below:

	Specific gravity at 15°C.	Strength of alcohol per cent	Refractive index at 25°C.
Fermentation alcohol	0.7937	99.97	1.3612
Synthetic alcohol	0.7939	99.97	1.3612

UTILIZATION OF ETHYLENE

All series of experiments carried out confirm the fact that on passing the gas at a lower velocity higher yields of alcohols are obtained; however, an excessive slowing down of the process is not economical. At the ratio of gas velocity and the size of the scrubber developed by the authors, whereby the same batch of acid was used, the utillization of the ethylene amounts to 60 to 63 per cent of the theory when using the silver catalyst, and, to 42 to 43 per cent when working without silver.

Gas produced in oil gas producers and left over after some of its constituents were used for other preparations is a fuel. The degree of utilization of the ethylene contained in this gas as well as of other unsaturates and homologs depends up on the commercial possibilities obtained by various methods of its utilization. As an illustration, it might be mentioned that the consumption of sulfuric acid in the treatment of the gas from which 50 per cent of the ethylene had been taken out may be less profitable than leaving the ethylene in the gas.

In case of necessity, for any reason, to utilize all ethylene contained in the gas, the former may be concentrated from the used gas (by the method developed by the authors) and it may then again be used in the preparation of ethyl alcohol.

In the apparatus constructed by the authors ethylene was utilized by 60 per cent when working with the silver catalyst and by 40 per cent when working with iron catalyst.

The yields of alcohol, on the basis of the raw gas produced in Baku (Russia) may amount to a yearly production of 7200 metric tons in the first and 4800 metric tons in the second case.

Conclusions as the result of this investigation include the following:

(1) Ethylene can be separated from the homologs by charcoal.

(2) Ethylene can be concentrated to 85 per cent when making use of the selective adsorption ability of the charcoal.

(3) Ethylene present in the cracked gas can be separated in the form of ethyl sulfuric acid and the alcohol can be separated by hydrolysis.

(4) Silver and iron are catalysts which accelerate the reaction.

(5) Technical or pure alcohol can be produced depending on the ratio between gas and charcoal.

(6) When working with the silver catalyst 13 to 15 per cent of alcohol can be produced from the gas.

(7) The iron catalyst gives a yield of about 8 per cent.

(8) The constants of the synthetic alcohol coincide with those of fermentation alcohol.

(9) Charcoal can be regenerated by treatment with steam superheated to 250 to 300°C.

STANDARD COSTS IN THE Oil Refining Industry

PART II

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Management Consultant—Chicago

IN this, the second article of a series dealing with cost accounting in refineries Mr. Harrison deals with setting standards for a standard cost system.

He brings into this work the most complicated cost problem in a refinery—that of the cost of clay used in connection with percolation filtration—a problem which, like the other problems in refinery cost accounting, he has helped solve in two of the largest refining companies in this country.

This series of articles is designed to be of specific value to the supervisory personnel, engineers and technical men responsible for the process operation of the industry.

The present article, and the next and concluding contribution deal with the setting of standards, the design of the system, its installation, and the operation of the standard costs method.

The work of introducing standard costs in an oil refinery naturally falls into four main divisions:

(1) Setting of the standards
(2) Design of the system
(3) Installation of the system
(4) Operation of the system.

To secure the desired results with the maximum of speed and with the minimum cost of both installation and operation, it is necessary before the project is started that a carefully worked out program be prepared. It should be understood that the introduction of standard costs in a large refinery is an undertaking of considerable magnitude and great complexity, and the attempt to introduce standard costs without proper planning and adequate preparation must necessarily result either in total failure or in securing results falling far below what could be achieved if the undertaking were properly planned and efficiently carried out. To attempt to introduce standard costs piece-meal for instance is a serious mistake — to secure effective results from standard costs it is necessary that there be a plan which completely coordinates all cost computations—both actual and standard—and this cannot be accomplished by introducing standard costs in one division of the business with the idea of determining whether standard costs will work or not—standard costs will always work if properly applied but they certainly will not work satisfactorily when introduced a little at a time.

(1) THE SETTING OF THE STANDARDS

The first essential, therefore, in the introduction of standard costs in an oil refinery is to sell the operating management completely on the value of standard costs to the operating man as an aid to him in controlling and reducing operating costs. Until this is done little can be accomplished, as rapid and effective installation of standard costs will demand enthusiastic cooperation and assistance from the operating force.

The first question which is usually asked when the possibilities of standard costs in an oil refinery are being discussed is "who sets the standards?" The answer to this is that this work is a function of the operating department. Oil refining operations are so complex that the setting of standards for them demands the experience of the practical operating man. When it comes to expressing standard cost data in the form necessary for their use in the standard cost plan, the operating man will require the assistance and guidance of the accounting expert, but as far as the determination of basic standard cost data is concerned this is something which comes absolutely within the province of the operating division.

There is another reason why standards should be set by the operating men. Considered from the angle of the use of a standard cost plan as an aid to operating management it is essential when comparisons of actual with standard costs are made, and particularly when these comparisons indicate that the costs are in excess of standard, that the operating man whose performance is judged by such statements can have confidence in their fairness and correctness, and he will not have this unless he is entirely sold on the standards by which he is being judged. In the writer's practice he insists that, before

being adopted, the standard cost schedules be approved by the operating men in charge of the departments affected.

The starting point in the setting of cost standards in the oil refining industry must necessarily be past performance and particularly past performance in months when a high degree of efficiency has been realized. Mere costs per thousand gallons considered without relation to volume are useless, obviously, because in any manufacturing process, and particularly in oil refining processes, due to fixed charges, costs per unit of production vary enormously with fluctuations in production these variations due to volume being often many times greater than could possibly result from any ordinary fluctuations in operating efficiency.

It is customary for oil refinery cost accountants to furnish the plant management with statements of costs of different operations figured out to several decimal points per gallon and how any practical use can be made of these statements, when they do not indicate to what extent cost variations from month to month have been due to fluctuations in production as distinguished from variations in operating efficiency, has always been a puzzle to the writer.

The correct way to furnish information regarding costs of production for the use of management, and, as a basis for the setting of cost standards, is illustrated on the graphic chart form (Figure 1.) On this chart actual monthly cost data are plotted for both costs and production. For instance the chart shows that the production in the month of April 1932 of a group of stills was 7,500,000 gallons and the cost of operating the stills $11,500. This information is plotted, as illustrated, by placing a small circle at the point where the horizontal line for $11,500 cost crosses the perpendicular line in respect to 7,500,000 gallons production.

In the setting of standards, for use in a standard cost plan, therefore, the first step is the preparation of charts, if these are not already available, showing all costs in relation to production—producing labor costs, steam and electric consumption, repair costs, etc. When this is done the charts will be carefully considered, the possibility of making reductions in personnel and expenses taken into account, and a standard cost line drawn, as shown in Figure 1, this showing the standard cost for the production of any expense item at all points of monthly production.

It will be noted that the form of chart illustrated renders it possible to determine both the fixed and variable costs of any operation. Extending the standard cost line to the zero production point gives the fixed charges: in the illustration $4000 a month, and figuring the total cost at any point of production, deducting the fixed charges, gives the variable costs, in the illustration these being $1.00 a gallon.

To determine a base standard cost it is necessary to establish a standard point of production—if we assume this to be 10,000,000 gallons a month, using the data shown on Figure 1 for illustrative purposes, the base standard cost per 1000 gallons is $1.40 arrived at as follows:

Total standard costs 10,000,000 gallons:	
Fixed Charges	$ 4,000
Variable Costs—	
10,000,000 gallons @ $1.00 per m gallons	$10,000
Total standard costs 10,000,000 gallons	$14,000
Total standard costs per 1000 gallons	$1.40

Different types of crudes will require different still

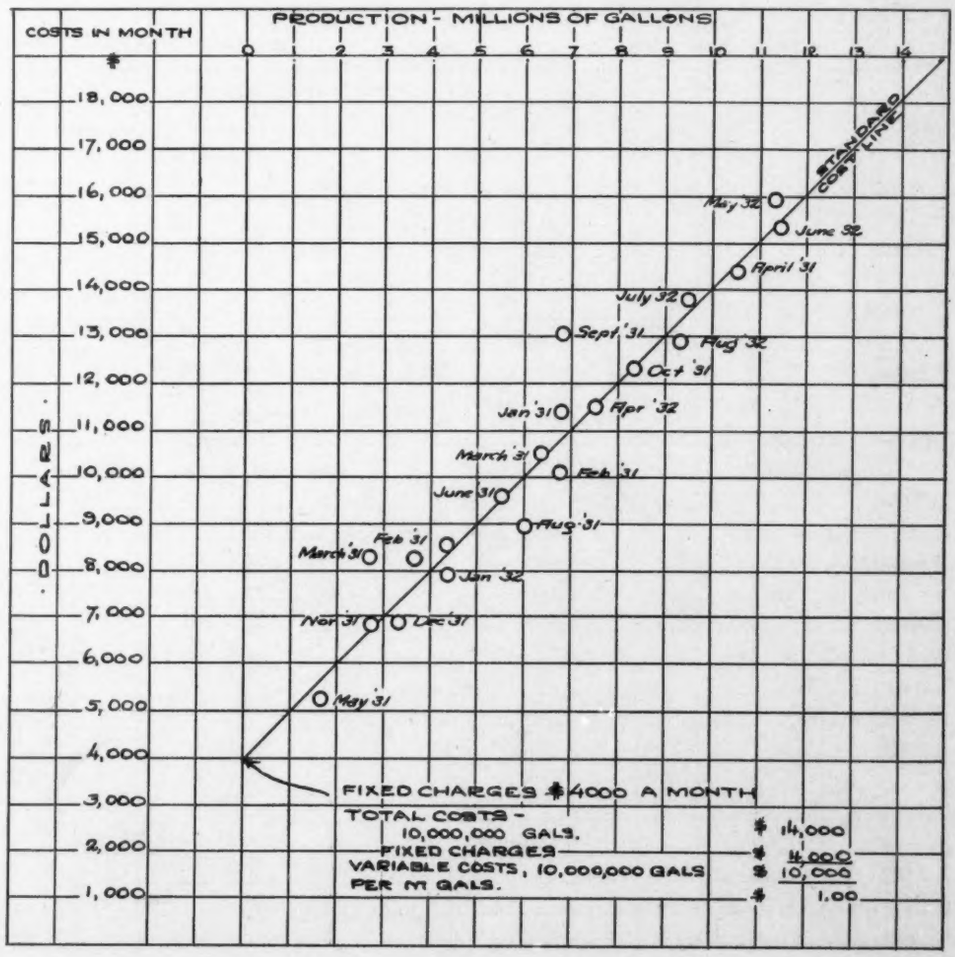


FIGURE 1

running times, and it will therefore be necessary to chart past performances to determine standard running times for these various crudes, and from these and from charts showing costs per still-hour, to prepare standard cost charts for the still costs of the different crudes.

When the costs of a given operation are comprised solely of fixed charges and, variable costs fluctuating directly with production, the standard cost line, of course, will necessarily be a straight line as illustrated on Figure 1. It will not always follow, however, that this will be the case—the fixed charges, for instance may be reduced when operations are curtailed, by the temporary laying off of position men, for example, in which case the standard cost line will be expressed by a series of steps as illustrated by Figure 2.

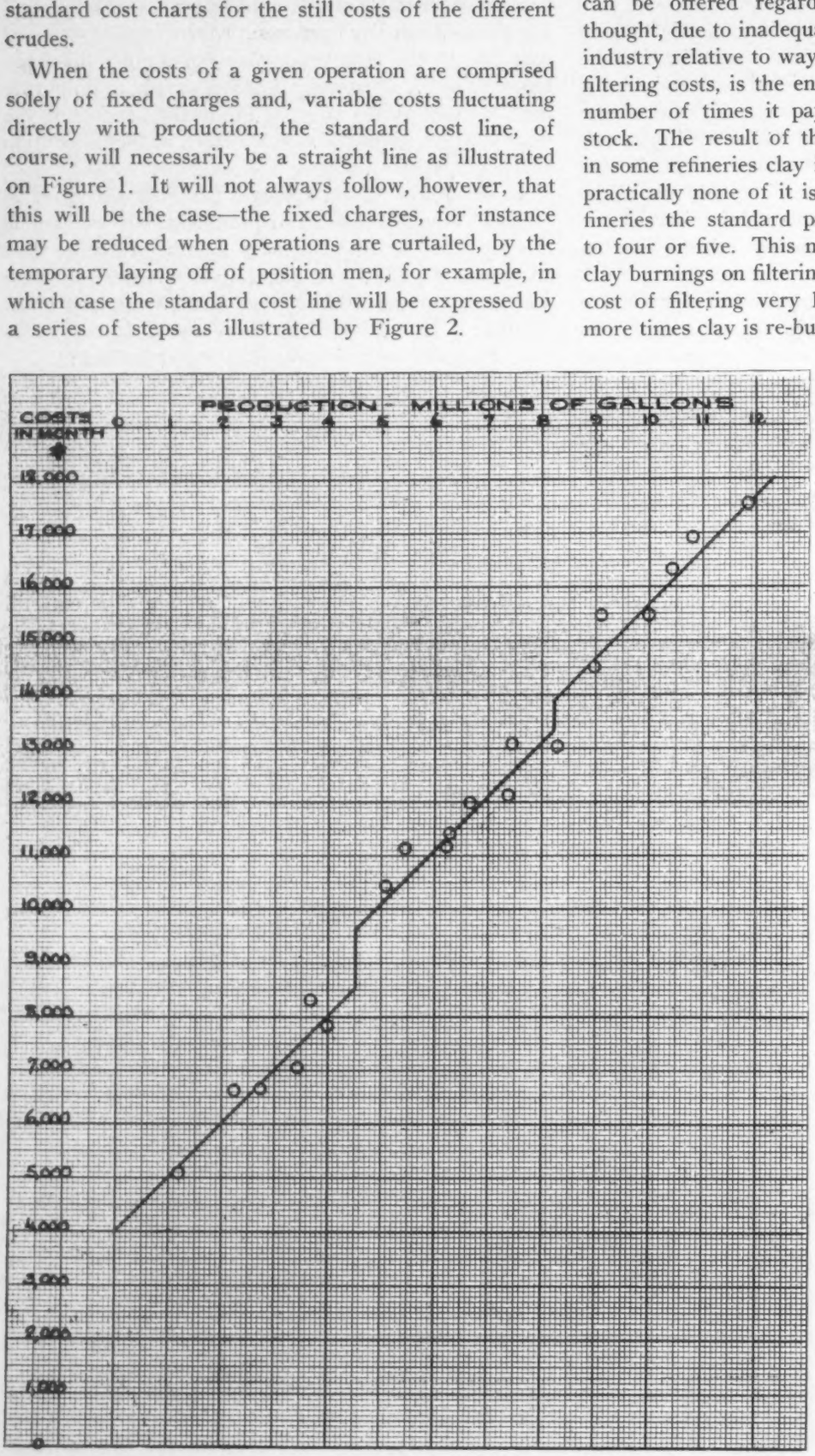


FIGURE 2

FILTRATION COSTS

The most complicated cost problem in an oil refinery is probably the cost of clay used in connection with percolation filtering, and perhaps the best evidence that can be offered regarding the general confusion of thought, due to inadequate cost data, which exists in the industry relative to ways and means to secure minimum filtering costs, is the entire lack of agreement as to the number of times it pays to re-burn clay for a given stock. The result of this confusion of thought is that in some refineries clay is re-burned so many times that practically none of it is discarded whereas in other refineries the standard practice is to limit the burnings to four or five. This matter of the effect of increased clay burnings on filtering costs is one on which the total cost of filtering very largely depends. Obviously the more times clay is re-burned the less the cost of clay per gallon of oil filtered. Clay is an expensive commodity and the natural tendency is to make a ton of clay go as far as possible by increasing the number of burnings to the maximum possible.

The monthly clay purchases are so definite and obvious an item on the cost statements that the effect of decreased or increased re-burnings is readily apparent to the management, whereas offsetting costs of over-burning are of a more complex character and in the usual refinery cost system are not disclosed, so that the natural tendency of the superintendent is to concentrate his efforts on reducing its clay costs without a full realization of the fact that in so doing he may very easily increase other costs to an amount far greater than any reduction in the cost of clay.

The more times clay is re-burned, the less efficient it becomes as a filtering agent; in other words, each time clay is re-burned the number of cubic feet of clay required to filter a given quantity of oil is increased. For example it may take only six cubic feet of fresh clay to filter 100 gallons of oil whereas it will take eight cubic feet of clay which has been re-burned three times to filter the same volume—in other words the re-burned

clay has only 75 per cent of the filtering efficiency of fresh clay.

The number of feet of clay required to filter a given quantity of oil, therefore, increases as the number of times the clay is re-burned increases, and this increase in volume of clay (though it will result in a decrease in the cost of clay owing to making a ton of clay go further through re-burning) automatically results in increased costs in other directions, and it is quite possible particularly in the case of oils of relatively high value, that the increased costs resulting from greater oil losses and oil depreciation will more than offset the savings in clay costs resulting from greater use of clay through increasing the number of times the clay is burned.

All other things being equal, it may be accepted as axiomatic that an increase in the volume of clay required to filter a given quantity of oil will result in offsets to the clay cost savings, as follows:

Due to more feet of clay being required to be handled to filter a given quantity of oil, in:

(a) Increased clay loading

(b) Increased clay dumping.

Due to the fact that the capacity of a filter is limited to a certain volume of clay, additional footage of clay to filter a given quantity of oil must necessarily result in:

(c) Increased filter hours

(d) Increased filter washing time.

Due to the fact that oil losses and oil depreciation tend to vary directly with the volume of clay in the filters (for any given oil stock) an increase in the cubic footage of clay to filter a given quantity of oil will result in:

(e) Increased oil loss

(f) Increased oil depreciation.

Due to the fact that the volume of naphtha required to wash-out filters (all other things being equal) will vary with the footage of clay to be washed, an increase in the footage of clay required to filter a given quantity of oil will result in:

(g) Increased naphtha in wash per gallon of oil.

Due to the fact that, all other things being equal, an increase in the gallons of naphtha in the wash will result in more naphtha being lost, an increase in the footage of clay required to filter a given quantity of oil will result in:

(h) Increased naphtha loss.

In view of the fact that the volume of steam required in the washing and steam-still operations tends to vary directly with the volume of clay to be handled in these operations, an increase in the footage of clay required to filter a given quantity of oil will result in:

(i) Increasing steam in washing

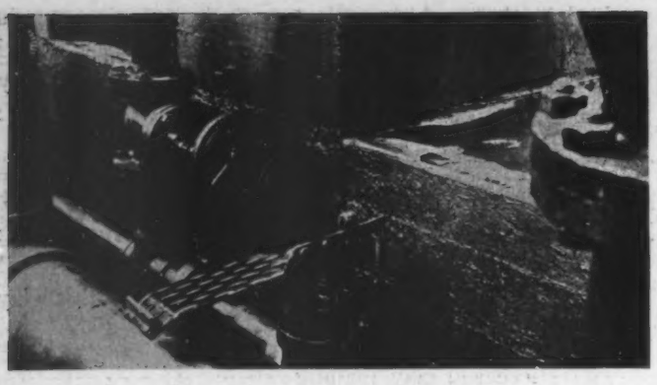
(j) Increased steam in steam-stills.

Summarizing, therefore, we have on the savings' side: Reduced cost of clay per gallon of oil due to increased clay burning and on the loss side, offsetting this clay saving we have:

(a) Increased clay loading
(b) Increased clay dumping
(c) Increased filter hours
(d) Increased filter washing hours
(e) Increased oil loss
(f) Increased oil depreciation
(g) Increased naphtha in wash
(h) Increased naphtha loss
(i) Increased steam in washing
(j) Increased steam in steam stills.

The importance of the above factors, considered from the standpoint of the ultimate costs of filtering, varies considerably depending largely upon whether the expense in question is a fixed or variable cost. In the case of clay loading and dumping for instance, these costs, as long as the plant is operating, are in the main fixed and no saving of any importance could be anticipated from a reduction in the clay volume, or conversely, no increased cost of importance from an increase in the volume of clay to be handled unless this reaches a point where the existing equipment and organization are unable to cope with it. Steam, however, is an item of great importance, and the additional volume required owing to excessive re-burning of clay may easily run into large figures. The problem is further complicated by the fact that due to the fixed charges of the steam plant the cost per 100 pounds of steam will be reduced by the additional consumption thereof.

This discussion of the complexities involved in the figuring of filtering costs has been introduced for the purpose of illustrating the impossibility of securing adequate information regarding the effect of the various cost factors in filtering under the established cost methods and the importance of more scientific cost accounting in oil refining. Standard costs are the only way yet devised to furnish the correct answer to such difficult questions as "how many times does it pay to reburn clay?"



Shut off for Mineral Seal Oil

Positive Shut-Off for Adding Mineral Seal to System

WHEN adding mineral seal oil or other absorbent to the system in a gasoline plant, the operator or stillman opens the gate leading from the storage tank to the suction of the lean oil pump. Often it is found that something at another point in the yard or plant requires his immediate attention, consequently upon rushing away from the pump room, the time element enters into the operation to such an extent that upon returning to the pump, he may find that the system has been filled to a point that the operation of the plant is effected adversely. A number of instances have been recorded in most every plant showing that when too much oil has been added to the system, the result has been either an off color product or one with an end point above that specified.

Gilmore Gasoline Company in its plants in the Long Beach field in Southern California have installed a novel method of providing for the addition of mineral seal oil, operated in such a manner that it will function only when the operator is standing "at attention." It is a simple device, placed in the fresh oil supply line near the lean oil circulating pump. All lines coming to and leading away from all pumps are in an open concrete lined conduit running the length of the pump room. Pumps are placed upon rather high foundation blocks and are spaced far enough apart that the operators may walk comfortably between them. The line leading from the fresh oil storage tank to the pumps are four-inch and are swedged into the six-inch suction line at the intake fitting of the lean oil circulating pump.

The fresh oil supply line being in the conduit, must rise to meet the suction connection at the pump, and in this riser is placed a four-inch block gate, maintained in a closed position at all times except when necessary to add oil to the system. At a point in line with the walk-way beside the lean oil circulating pump, a four-inch balanced valve is inserted in the fresh oil line that requires the act of depressing the stem to open. The lever and supporting yoke originally fitted to the valve body cover was left intact, except that a portion of the lever was cut away. An additional yoke was connected to the rear supporting cover bolts, to which a strong spring was hooked, short enough that when the other end was connected to the rear of the valve actuating lever, it would hold the stem up and the valve closed.

As the lever lies at right angles to the flow of fluid in the pipe, it was cut off to permit the welding of a short piece of safety tread iron to it, forming a step upon which the operator must stand when charging fresh oil to the system.

When it is necessary that fresh oil be added to the system, the operator opens the block valve near the suction of the lean oil pump. But, the strong spring attached to the rear of the operating arm of the valve prevents oil being taken from the supply line. He then places his foot on the pedal attached to the operating arm and stands upon it, opening the valve which permits fresh oil to be taken up by the lean oil pump. If for any reason he finds that he must leave the pump room, the simple act of raising his foot from the balanced-valve furnishes the right amount of energy to close the valve. If the operator is watching the gauge in the system, no more oil than that necessary for filling the system can enter.

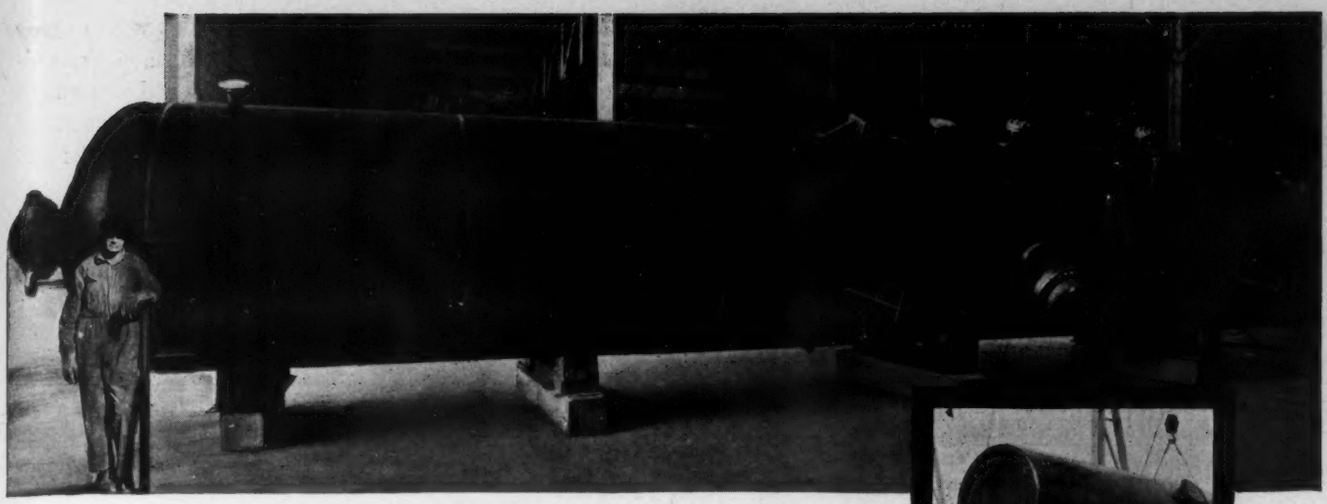
Rack Keeps Ladders in Place

MANY times when looking for a ladder to raise against a line to make adjustments or repairs, that particular piece of equipment is hard to find. They are either stored in the parts room, against a building, or scattered somewhere around the yard.

Cromwell-Franklin Gasoline Company has built a simple inexpensive rack upon which the ladders ordinarily used in the yard are stored when not in use at the Trosper Park plant at Oklahoma City. When an operator finishes with the particular ladder, it is immediately replaced upon its rack so that all employes at the plant know just where to get it.

Beside the railing near the engine room, two short pieces of three-inch pipe were set in concrete, with the upper ends remaining open. Into these open ends, two pieces of sucker rods were placed, bent in such manner that they formed hooks upon which the ladders may be placed with a minimum amount of trouble and effort.

Rack for keeping ladders in place



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DR. E. H. LESLIE and DR. H. B. COATS

The abstracts here presented are selected from the current literature of science and technology to afford reference to fundamental information not easily available to all readers. Abstracts of articles appearing in readily obtainable trade journals are not included.

Photostat copies of original articles will be supplied at cost by the Leslie Laboratories. Complete or limited bibliographies covering special topics by title, by abstract, or in complete manuscript, will also be prepared and furnished at reasonable cost by the Laboratories.

Chemical Composition and Reactions

Synthesis, Purification and Certain Physical Constants of the Normal Hydrocarbons from Pentane to Dodecane, of n-Amyl Bromide, and n-Nonyl Bromide. B. J. MAIR. *Bur. Stand. J. Res.* **9** (1932) pp. 457-72.

The normal paraffins, n-amyl bromide, and n-nonyl bromide were synthesized and prepared in a pure condition in connection with a study of the electrical properties of insulating liquids. Cooling curves, indicating the degree of purity, are given. The boiling points, freezing points, and refractive indices have been measured and compared to values obtained by investigators who have isolated these hydrocarbons from petroleum. The agreement, although not absolute, is far superior to that usually obtained by investigators of the physical properties of organic liquids.

Preparation of Paraffins from Carnauba Wax by Means of Catalytic Hydrogenation. H. I. WATERMAN, P. DE KOK AND S. TULLENERS, *Jour. Inst. Petrol. Tech.* **18** (1932) pp. 1007-10.

Carnauba wax is composed largely of mycicyl-alcohol, $C_{30}H_{61}OH$, in the free and ester state. It also contains ceryl alcohol, cerotic acid, and small amounts of other higher alcohols, acids, and hydrocarbons. The oxygen is removed almost quantitatively by high-pressure hydrogenation in the presence of molybdenum-carbon or nickel-guhr catalysts. The product is composed of high molecular weight paraffins.

The Reaction of Sulfur with Hydrocarbons. F. J. NELLENSTEYN AND D. THOENES. *Chem. Weekblad.* **29** (1932) pp. 582-7.

In an effort to determine the role of sulfur in the formation of natural asphalts, the authors heated paraffin, kerosene, lubricating oil, and liquid sulfur dioxide extract of lubricating oil with 10% S at temperatures from 135°C. to 300°C. Most of the sulfur was recovered as H_2S, and the sum of asphalt and coke formed was proportional to the H_2S formed.

Equilibrium Dehydrogenation of Ethane, Propane, and the Butanes. F. E. FREY AND W. F. HUPPKE. *Ind. Eng. Chem.* **25** (1933) pp. 54-9.

Ethane, propane, n-butane, and isobutane are dehydrogenated to the corresponding olefins and hydrogen at 350°C. to 500°C., and at 760 mm. pressure, in the presence of a catalyst prepared from air-dried chromic acid gel. The equilibrium dissociation is secured with little interference from side reactions. Equilibrium constants were determined for several reactions. The extent of the dissociation increases with increase in the number of alkyl substituents attached to the ethylene group in the olefin produced. The equilibrium dissociation is the same for l-butane as for propylene. Apparatus and methods are described. Data are tabulated and presented graphically. Free energies of dehydrogenation are tabulated.

Fundamental Physical Data

Specific Heat and Dissociation of Simple Hydrocarbons. R. RUEDY. *Can. J. Research* **7** (1932) pp. 328-36.

The sp. hts. at constant volume of CH_4, C_2H_4 and C_2H_2 were computed from the vibrational frequencies involved in the Raman effect and infra-red bands. They agree with data from recent experimentation. The heat of dissociation of CH_4 into CH_3 and H is calculated as 101 cal. per mole. The need for studying the velocity of ultrasound in gases to gain a better knowledge of thermal decomposition processes is pointed out.

The Heats of Combustion and Formation of Carbon Monoxide and Methane. W. A. ROTH AND H. BANSE. *Arch. Eisenhuttenw.* **6** (1932) pp. 43-6.

At 20°C. and constant volume in a bomb colorimeter the heats of combustion of CO and CH_4 were found to be 67.58 ± 0.25 kg. cal. per mole respectively. At constant pressure these values are 67.87 ± 0.10 and 213.2 ± 0.25. Considering the data of Rosini, the authors recommend use of the values 67.70 and 213.0 for the heats of combustion of CO and CH_4 at 20°C. and constant pressure.

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Manufacture, Processes and Plant

Thermal Conductivity and the Plate Efficiency in a Rectifying Column. C. P. WARDEN. *Jour. Soc. Chem. Ind.* **51** (1932) pp. 405T-411T.

The rectification of ethyl alcohol and water was studied under conditions of constant reflux-ratio and total condensation in three columns constructed of materials of differing thermal conductivity. It was found that the plate efficiency was highest when using the plate constructed of material of highest thermal conductivity.

Fluid Friction and Its Relation to Heat Transfer. C. M. WHITE. *Trans.*

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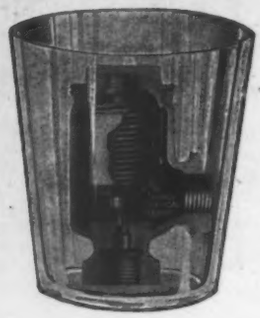

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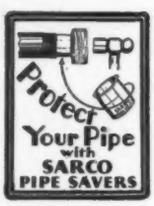

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Inst. Chem. Engrs. (London) Oct. 7, 1932, pp. 3-17 (Preprint).

The paper deals with the prediction of heat-transfer coefficients from fluid friction data. The case of axiol flow through tubes is analyzed in detail, and, following that, friction and heat transfer in coiled tubes and in paths obstructed by obstacles.

The Refining Process With Liquid Sulfur Dioxide. L. EDELEANU. *Jour. Inst. Petrol, Tech.* **18** (1932) pp. 900-20.

The authors Redwood medal address before the institution of Petroleum Technologists, in which his 25 years of work on the liquid sulfur dioxide refining process is recounted. Work on the process was started by the necessity for obtaining lamp oil from Rumanian distillates that would be comparable to kerosenes from Pennsylvania. The selective action of sulfur dioxide is different for the different groups of hydrocarbons and is a function of temperature. Paraffin hydrocarbons are practically insoluble in sulfur dioxide. Naphthenes are but slightly soluble at —10°C., but more soluble at higher temperatures. Aromatic and unsaturated hydrocarbons are soluble at all temperatures. However, the paraffins and naphthenes tend to dissolve in the sulfur dioxide phase as the concentration of aromatics and olefins increases in this phase. The more difficult a distillate is to treat with sulfuric acid the more marked is the advantage of sulfur dioxide. The treated distillate plus raffinate removed equals the original distillate in weight. Chemical structure is not changed by sulfur dioxide. Sulfur dioxide is recovered completely for re-use. The raffinate extracted from naphthas or light kerosene is a good anti-knock addition for gasoline. Lubricating stocks treated with sulfur dioxide show a better viscosity, lower carbon residue, and greater resistance to oxidation. Turbine oils, transformer oils, and white oils are tested with peculiar advantage. The early batch method of treatment has been replaced by a continuous process. The guaranteed consumption figures for a kerosene treating plant, per 1000 kg. of kerosene, are: steam 340 kg., power 4.2 KWH, sulfur dioxide 2.2 kg., Circ. water 22 cu. meters. A flow-sheet of the process is presented and explained. A bibliography of 42 references is included. The prediction is made that the process will be of increasing importance as the petroleum industry embraces chemical manufacture to an increasing degree.

Lowering Sodium Hydroxide Consumption in Refining Lubricating oils. B. RUIBAK. *Azer. Neft. Khozyaistro* 1932, No. 8-9, pp. 55-9.

In refining Balakhanui cylinder stock, of 0.9145-0.9159 sp. gr. and 6.60-6.75 Engler viscosity at 50°C., treated with sulfuric acid, the consumption of NaOH can be reduced 60% by washing the acid oil with NaCl solution or with water in the presence of steam. Preliminary neutralization with spent NaOH solution will effect a 26% saving, or coagulation of sludge with lime water a 50% saving.

Hydrogenation of Petroleum Products. A. SACHANOV AND B. TARASOV. *Petrol. Zeits.* **28** (1932) No. 46 pp. 1-4.

The influence of physical factors on the hydrogenation of kerosene below cracking temperatures was studied. Reduction of olefins was the chief result. Aromatic hydrocarbons were hydrogenated only when spongy Pt or Ni on kaolin was used as catalyst. Increase in hydrogen pressure, temperature, and catalyst surface aided the reduction. Distillation of higher boiling range than kerosene are more resistant to hydrogenation. The hydrogen absorbed is small in

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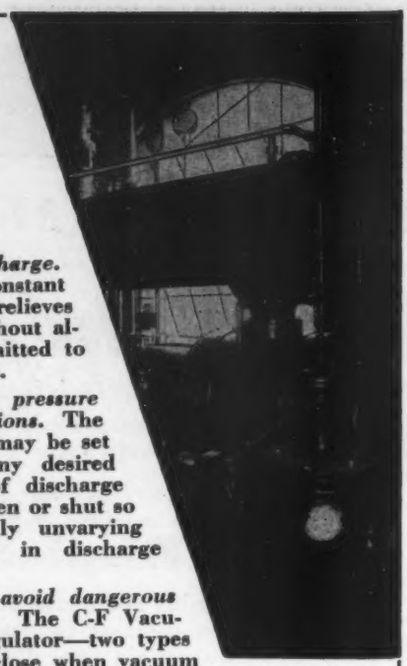

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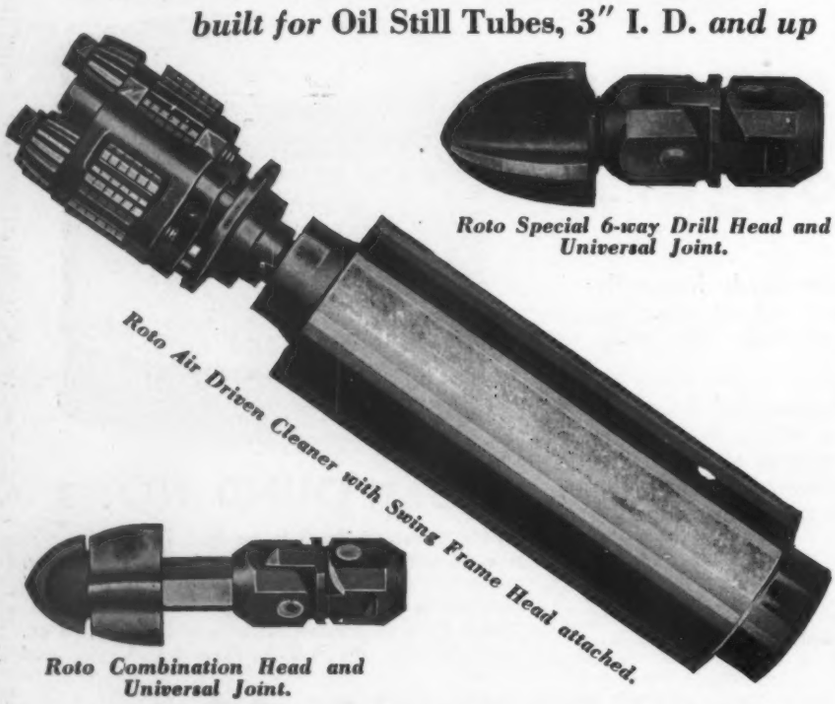

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comparison to operation at 425°C. or higher temperature. This indicates that the larger part of the hydrogen used at the higher temperatures is consumed in secondary hydrogenation.

Synthetic Lubricating Oils from Gaseous Olefin Hydrocarbons. A. D. PETROV, L. I. ANTZUS AND E. N. POZHIFTZERA. *J. Applied Chem.* (U.S.S.R.) 5 (1932) pp. 790-6.

Lubricating oils made from cracked gas by use of anhydrous $AlCl_3$ contain less aromatics and are of better quality when the reaction temperature is low. The synthetic oils are more homogeneous than natural mineral oils, as is shown by their distillation characteristics.

The Manufacture of Greases. W. MAASS. *Petrol. Zeits.* **28** (1932) No. 38, pp. 1-16.

The formulas for and methods of preparation of 49 commercial greases are given.

Ceresin and Paraffin in Chelekenvi Ozocerite. L. G. SHERDEVA AND R. I. BERLIN. *Neftyanoc Khozyaistro* **21** (1931) pp. 35-44.

The crude ozocerite is vacuum-distilled, yielding 30% of oil and paraffin. The last fraction is a slack-wax of 50°C. m.p., and the residue, called standard ozocerite, is a commercial product. Standard ozocerite is treated with fuming H_2SO_4 at 150-200°C. and clay is added without discontinuing the agitation at a temp. of 120°C. The product is filter-pressed. The finished ceresin of 78°C. m.p. is approximately 55% of the comm. ozocerite. From this material the investigators produced a 25-30% distillate by vacuum distillation at 4-7 mm. Hg. and a residue that was treated with fullers earth and activated carbon. Five fractions were separated by fractional precipitation from gasoline solution or from solvents containing ethyl acetate and butanone. The fractions were treated with activated carbon. The fraction melting at 85.5°C. amounted to 60%. These ceresins are characterized by higher viscosities, mol. wts., nitrobenzene points, and sp. gr. in the solid as well as liquid state as compared to the paraffins. The physical properties of the ceresins and paraffins are compared and micro-photographs of each are given.

The Use of "Availability" in Process Steam Cost Accounting Practice. W. L. MCCABE. *A.I.Ch.E.* (Preprint) Washington Meeting Dec. 1932.

If cost data are to be used as a guide to the operations of the component parts of a complete plant it is important that a sound method be used for determining the costs of steam and power. The method proposed is based on a modification of Keenan's function "availability" and employs a concept of "equivalent power." The purpose of the paper is to present and analyze this modified cost-accounting method and to apply it to a few typical cases of power and process steam combinations. The relationship between availability and equivalent power is shown.

Pipe Line Protection. STANLEY GILL. *Ind. Eng. Chem.* **25** (1933) pp. 49-53.

It is estimated that there are 450,000 miles of buried pipe lines in the U. S., containing 30,000,000 tons of steel. The annual loss by corrosion has been estimated to be $142,500,000. A coating that positively prevents access of moisture to the surface of the metal precludes possibility of corrosion. Continued impermeability of pipe line coatings is dependent on resistance to chemical and bacterial action, freedom from capillary

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pores, resistance to mechanical distortion or "soil-stress action." The materials discussed include oil paints, bituminous "cut-backs," asphalt emulsions, greases, lacquers and synthetic resins. The most effective coatings at present available are the molten bitumens. Synthetic resins offer possibilities. Some work has been done on bituminous mastics. Satisfactory portland cement coatings can be made but are costly. In recent work a dense coating one inch thick has been applied using movable metal forms and vibrators. Pipe coated with vitreous enamel has been sold in Germany and is now available in this country. The author concludes that a large field for development of improved methods exists.

Water Content of Certain Fire-Protective Media. M. G. MELLON AND J. E. HICK. *Ind. Eng. Chem.* **25** (1933) pp. 94-5

Fire-proofing insulating materials such as natural and portland cements, gypsum plasters, used alone or in admixture with celite or Kieselguhr, contain water and lose water over a period of 2½ years or more. The fire protective properties are believed to be connected with the water content of the material as well as with the thermal insulating value.

Products: Properties, Utilization and Testing

Roumanian Transformer Oils. N. DANAILA AND M. BOLTUS-GORUNEANU. *Petrol. Zeits.* **28** (1932) No. 45, *Motorenbetrieb u. Mech. Schmierung* **5** No. 11, pp. 4-7.

A good sulfur-free transformer oil can be made from Moreni crude by distillation under vacuum and treating the fraction with successive portions of 15% and 5% of 80% sulfuric acid at a temperature of 60°C. Treatment with silica-gel or liquid sulfur dioxide did not reduce the tar number sufficiently.

The Physical Properties of Mixtures of Bitumen and Finely Divided Mineral Matter. A. EVANS. *Jour. Inst. Petrol. Tech.* **18** (1932) pp. 957-91.

The paper reports a detailed study of the physical properties of mixtures of residual bitumens and various types of finely divided mineral matter, that is, so-called "asphaltic cements." Bitumens of 40/50, 60/70, and 190/1210 penetration (I.P.T.) were used. The fillers studied were semi-colloidal silica, portland cement, ground chalk, ground limestone (orig. sample, 200 mesh, 120/200 mesh) micro-asbestos, slate dust, and mineral filler from Trinidad Lake asphalt. These were used in different proportions. It was found that melting point, hardness, and tensible strength are raised and the ductility increased by (1) increase in proportion of filler, (2) increase in hardness of bitumen, (3) increase in fineness of filler, (4) Fibrous or lamellar as distinct from cubical structure of filler, (5) increase in the bitumen adsorptive capacity of the filler. There is no relationship between the chemical composition of the filler and the properties of the cements. No simple relationship exists between the penetration ductility, tensile strength, and melting points of the asphaltic cements. Hence, each must be determined if proper conclusions are to be drawn as regards the suitability of a particular cement for a given purpose. The ductility of the original bitumen is not a guide to the ductility of the cement, although there is a broad parallelism of these ductilities. The most important conclusion drawn from the work is that the ratio of filler to bitumen must be maintained within narrow limits in order to manufacture cements of desired properties. Failures in pavements,

often ascribed to the bitumen, are frequently caused by incorrect filler-bitumen ratio.

Influence of Air-Humidity on the Estimation of Knock-Rating. A. W. SCHMIDT AND F. SEEBER. *Erdol und. Teer* **8** (1932) pp. 493-5.

The effect of atmospheric humidity on knock-rating was investigated. The fuels used included a gasoline of low-knock rating, a commercial gasoline, a natural gasoline, and a blended gasoline. These were tested at relative humidities varying from 30 per cent to 90 per cent. Up to 45 per cent humidity had little effect on the octane number, but above this large differences were found. For example, 56 octane at 40 per cent humidity and 64 octane at 70 per cent humidity for the poor gasoline, 68 octane at 50 per cent and 76 octane at 82 per cent humidity for commercial gasoline. The lower the octane number of a gasoline the larger the effect of humidity on octane number determination. Large variation in humidity occur during a day, e. g. from 94 per cent in the morning to 50 per cent at noon and 86 per cent in the evening. The effect of adding known amounts of benzol to a fuel were studied. By plotting benzol addition, relative humidity, and octane number on a 3-coordinate diagram, octane numbers can be reduced to a basis of constant humidity.

An Analysis of Lubricating Oils by Fractionation with Acetone. M. NOTTAGE. *Jour. Inst. Petrol. Tech.* **18** (1932) pp. 943-52.

Two oils of widely different origin, one from Burmah and one from Pennsylvania were examined to determine whether the "diluent", that is, the components of the oil that are unreactive from a lubricating standpoint, were the same in both oils. By exhaustive extraction with acetone the diluent portion was secured from each oil. The coefficient of friction of these diluent portions is independent of temperature and of the surrounding atmosphere. The values were 0.200 for the Burmese diluent and 0.139 for that from Penna. oil. The first was light colored and the latter dark colored. The two diluents are believed to be of quite different chemical nature.

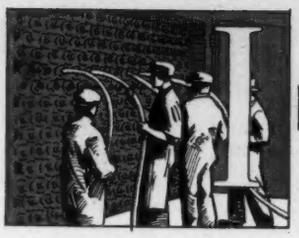
The Demulsification of Mineral Lubricating Oil. L. HEMMER. *Ann. Combustibiles Liquides* **7** (1932) pp. 589-634.

The influence of the physico-chemical properties of oils on the velocity of demulsification was studied. The test for demulsibility of an oil is best made by use of aqueous solutions having a P_H between 6 and 11 and at a temperature of 20°C.

Natural Gas

High-Heating-Value Oil-Gas as Standby for Natural Gas. L. J. WILLIEN. *J. Western Soc. Engrs.* **37** (1932) pp. 272-83.

High B.t.u oil-gas can be used as a substitute for natural gas in the event of interruption of the natural gas supply. Tests conducted at San Diego and San Rafael, Cal., indicate that the oil-gas can be used with standard adjustment and that 30% can be included without inconvenience to customers. In emergency, 100% oil-gas would give reasonable service to 98% of the customers if absolute burners are eliminated. A 960 B.t.u. oil-gas makes the best substitute for 1190 B.t.u. (sp. gr. 0.66) natural gas. The percentage of fast-burning components in the oil-gas is important as too high a percentage causes flashing-back in burners.



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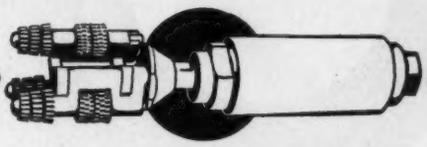
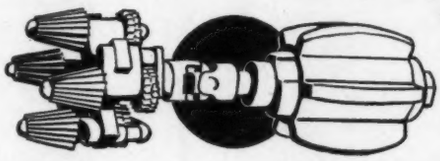
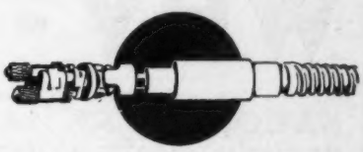
Lagonda cleaners are proving their extraordinary ability to do  a quick, thorough job of cleaning any tube or pipe that fouls. Still tubes, large pipes, small heat exchanger  and condenser tubes—there is a Lagonda cleaner that will clean them to your utmost satisfaction . . .

Refer to tube cleaner  headquarters—Lagonda—for the solution of any tube cleaning problems. Our thirty years experience is at your service.

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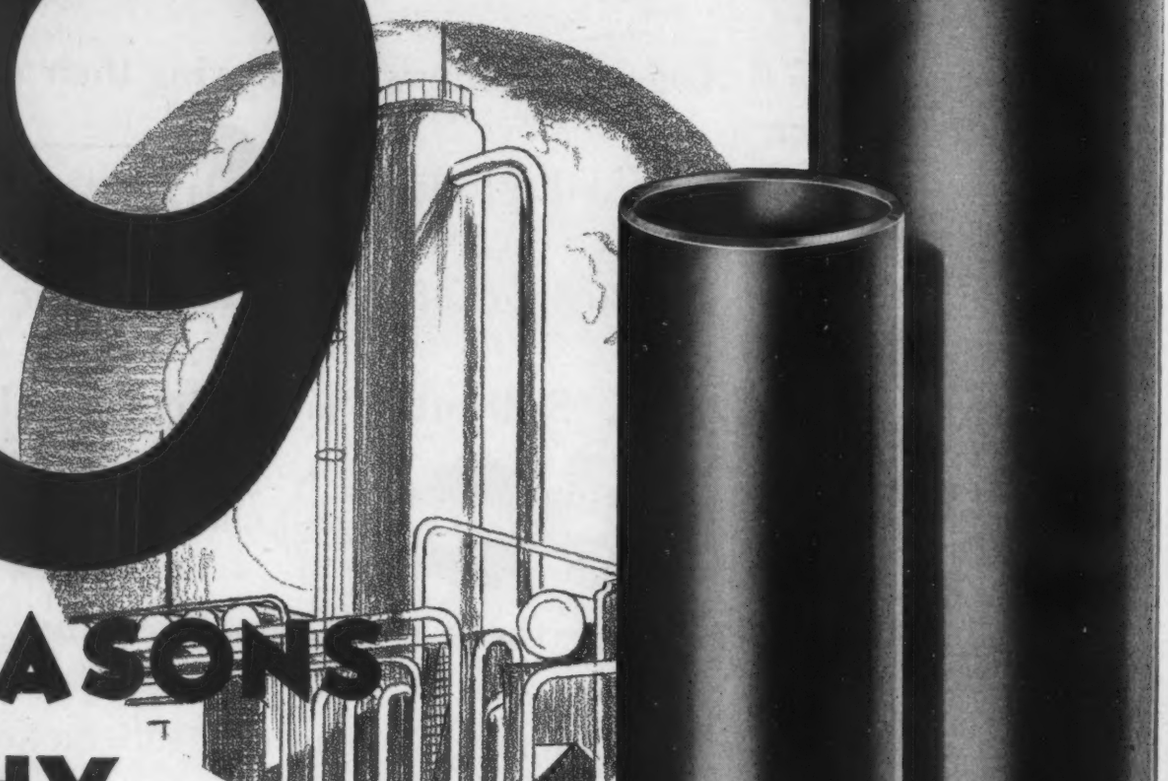

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THE MONTH IN REVIEW

Economics Committee Report Sees Lower Demand

PROBABLY not more than 370,000,000 barrels of crude oil will be required to meet domestic and export demand during the first half of the current year, it was made known March 1 with the publication by Secretary of the Interior Wilbur of the requirement report of the Voluntary Committee on Petroleum Economics of the Federal Oil Conservation Board.

This expected demand will represent a reduction of more than 34,000,000 barrels from the requirement estimate for the first half of last year.

Explaining that the total demand for motor fuel during the six months ended with next June will approximate 177,400,000 barrels, or a decline of 12.4 per cent from the adjusted figures for the corresponding period of last year, the committee urges the petroleum industry to "do everything possible to adjust its economic set-up to the trend in automobile use."

The committee again calls attention to the relationship between domestic motor fuel demand and the number of automotive units in use at any given time. "It is significant to the petroleum industry that the trend in the reduction of cars on the highways is accumulative in its effect," it is pointed out. "The curve of reduction is steepened by the failure of added cars to flatten it out. If the number of cars sold in 1933 does not exceed that of 1932, the total number of cars on the road will shrink more than 200,000 a month. This means a withdrawal of gasoline consumption supporters at the average rate of approximately one per cent a month."

The total domestic demand for motor fuel during the first half of this year is estimated by the committee at 164,000,000 barrels, the remaining 13,400,000 barrels being for export trade, regarding which the committee says, "there appears to be nothing that will markedly change the present trend and the reduction is anticipated to be nearly 40 per cent compared with the same period in 1932. Should the present low prices prevail for any long period, exports might be increased a few million barrels."

Making allowance for the blending of 600,000 barrels of benzol, the use of 4,600,000 barrels of natural gasoline, the blending of another 11,600,000 barrels of natural gas at refineries and an increase of 2,000,000 barrels in stocks, the committee finds that 152,600,000 barrels will be needed from crude petroleum refining, which will require approximately 370,900,000 barrels, part of which is expected to be withdrawn from storage.

The committee makes no attempt to indicate the required production of crude oil. Domestic runs to stills are estimated at 368,500,000 barrels, exports at 13,000,000 and miscellaneous uses and losses at 5,400,000, against which are estimated imports of 16,500,000 barrels, the daily domestic demand therefore being 2,049,000 barrels.

"The industry will, no doubt, work toward a reduction of stocks," the committee stated in commenting upon the 165 days' supply held on December 31 last. "A production of 2,000,000 barrels per day, taking all oil recorded and otherwise into account, would make for a reduction of stocks of 8,000,000 barrels. As there is no evidence that there is any likely upward movement in demand for petroleum products in the near future and there is strong reason to believe that the demand will, at least for the period under consideration, continue to decline, it would hardly seem necessary to point out that the trend of petroleum production and petroleum refining should follow the trend of consumption."

A.P.I. Forecast Advises Restricted Refinery Runs

DEMAND for gasoline in the first half of 1933 will be 7.6 per cent less than for the corresponding period of 1932 as estimated by the American Petroleum Institute Committee on Refinery Statistics and Economics. This along with other forecasts was made public last week in an interim statistical survey. Outstanding features of the report were given as follows:

Reduction of motor fuel demand by 7.6 per cent.

Stocks on hand June 1 should not exceed 50,428,000 barrels.

Crude oil charged to stills should average 2,090,000 barrels daily.

Concerning the reduced demand for motor fuel the report is to the effect that domestic consumption will decline but 4.8 per cent or 15,250,000 barrels, while exports will be reduced by 31.4 per cent, or 6,750,000 barrels. The drop in exports represents not so much a falling off in foreign consumption as

A.P.I. Summary of Forecast of Demand, Economic Stocks and Required Supply
January 1 to June 30, 1933 (Forecast)
vs.
January 1 to June 30, 1932 (Actual)
(In Thousands of Barrels)

Item—	First Quarter, 1933 Total	First Quarter, 1933 per cent Change	Second Quarter, 1933 Total	Second Quarter, 1933 per cent Change	Six Months Total	Six Months per cent Change
MOTOR FUEL						
DEMAND						
Total	84,700	— 6.3	100,700	—*8.7	185,400	—*7.6
Domestic	77,400	— 4.6	93,500	—*5.0	170,900	—*4.8
Exports	7,300	—20.7	7,200	—39.7	14,500	—31.4
STOCKS						
Change During Period	+5,920	...	—8,360	...	—2,440	...
Beginning of Period	52,868	...	58,788	...	52,868	...
End of Period	58,788	...	50,428	...	50,428	...
SUPPLY						
Total	90,620	—11.8	92,340	—15.8	182,960	—13.9
From Imports	.....	...	.....	...	.....	...
From U. S. Producers	90,620	— 8.6	92,340	—12.6	182,960	—10.7
Straight-run	43,270	—10.3	43,980	—16.6	87,250	—13.6
Cracked	38,420	— 6.3	39,690	— 9.0	78,110	— 7.7
Natural Gasoline	8,630	—10.0	8,370	— 6.9	17,000	— 8.5
Benzol	300	—10.8	300	+ 6.9	600	— 5.7
CRUDE OIL						
DEMAND						
Total	200,580	— 2.3	199,590	—13.0	400,170	— 7.9
Export	6,000	— 8.8	6,600	—23.3	12,600	—10.7
Domestic	194,580	— 2.6	192,990	—12.6	387,570	— 7.8
Runs to Stills	190,080	— 4.4	188,490	—13.6	378,570	— 9.2
Used as Such	2,700	...	2,700	...	5,400	...
Transfer to Fuel (Calif.)	1,800	...	1,800	...	3,600	...
STOCKS						
Beginning of Period	338,718	...	.....	...	.....	...
End of Period	.....	...	.....	...	.....	...
SUPPLY						
Total	200,580	— 2.3	199,590	—13.0	400,170	— 7.9
From Imports	7,800	—31.9	7,000	—66.1	14,800	—53.8
From Domestic Production						
From Stocks	192,780	— 0.6	192,590	— 7.7	385,370	— 3.3
DAILY AVERAGE DOMESTIC CRUDE OIL REQUIREMENTS (From Production & Stocks)	2,140	— 0.6	2,120	— 7.7	2,130	— 3.3

NOTE—Per cent change calculated on daily average basis due to February, 1932, having 29 days.

*These percentage changes not only take into account wherever necessary the fact that February, 1932, contained 29 days but also the fact that shipments during June, 1932, were abnormally high to the extent of approximately 5,700,000 barrels due to the purchase of large quantities of motor fuel early in June in anticipation of the Federal one cent tax.

it does the realignment of sources of supply whereby gasoline is now furnished from sources other than refining centers of the United States.

The estimate of stocks required for June 1 is 10,000,000 barrels less than that recommended for the corresponding date of last year. Estimates as of March 1 are that stocks on hand then were 57,498,000 barrels. The observation of the committee is to the effect that conditions are favorable for reaching the lower figure by June 1.

Although runs to stills was set at 2,090,000 barrels daily for the first half of the year, the recommendation for March, April and May is 2,070,000 barrels daily.

The report was made by the committee of which D. J. Moran is chairman. Its details were prepared by the subcommittee, headed by W. A. Sinsheimer, the chairman.

Details of the report are shown in the accompanying table:

Analysis of Conroe Crude Oil

CRUDE oil being produced in the increasingly important field at Conroe, Texas, is classed as high gravity, sweet oil and yields relatively large quantities of straight run gasoline having an octane rating better than average. The crude is low in sulphur content, little wax, low cold test, and easy to refine and crack. No difficulties are encountered in treating either the straight run or cracked products.

The field is rapidly growing in importance and its production is moving mostly to the Gulf Coast for refining and shipment to Atlantic Coast refineries.

The following analysis give the characteristics of the products derived from the crude and the crude itself.

Conroe Crude Analysis

Gravity, ° A.P.I.	38.2
Sulphur, %	.04
Color	Dark Green

(a) Naphtha

	Spec. 400 E.P. naphtha
Per Cent	39.8
Octane No.	60.8
Sulphur (untreated), %	.03
% at 212° F	15.5
% at 284° F.	54.0
Final boiling point, ° F.	400
Gravity, ° A.P.I.	50.8

(b) Kerosene

	Kerosene after 400 E.P. naphtha
Per cent	20.4
Gravity, ° A.P.I.	35.9
R. O. viscosity	475
Sulphur, %	.04
Final boiling point, ° F.	512

(c) Other Products

	Gas oil past the normal 475 ref. oil	Cracking stock past the gas oil	Bottoms
Range of cut, %	60.2-80.0	80.0-95.0	95.6-100
Per cent	19.8	15.0	4.4
Gravity, ° A.P.I.	32.5	28.2	17.3
Flash, ° F.	235	...	535
Vis. at 210° F.	...	...	278
Pour test, ° F.	30	...	...
Sulphur, %	.13	.27	.42
Aniline point, ° F.	162	...	...
Final boiling point, ° F.	638	...	...

Distillation of Crude Controlled Reflux Still

Tests on Crude

Gravity, ° A.P.I.	38.2
Vis. at 100° F.	32
Flash, ° F.	R. T.
B.s. and w., %	.3
Sulphur, %	.04
Color	Dark green

Distillation of Crude

Charged 16,000 cc. over at 250° F. Steam in at 450° F.

Cut No.	Range of cut %	Temp. ° F.	Gravity ° A.P.I.
1	0.0-10.0	375	65.2
2	10.0-12.5	395	51.1
3	12.5-15.0	405	50.5
4	15.0-17.5	410	50.1
5	17.5-20.0	420	47.2
6	20.0-22.5	430	45.6
7	22.5-25.0	440	45.3
8	25.0-27.5	450	45.0
9	27.5-30.0	460	44.5
10	30.0-32.5	470	44.3
11	32.5-35.0	475	43.7
12	35.0-37.5	485	42.7
13	37.5-40.0	490	41.3
14	40.0-42.5	495	40.4
15	42.5-45.0	500	38.7
16	45.0-47.5	510	37.2
17	47.5-50.0	520	35.9
18	50.0-52.5	530	35.2
19	52.5-55.0	535	34.3
20	55.0-57.5	545	33.5
21	57.5-60.0	555	32.8
22	60.0-62.5	560	32.6
23	62.5-65.0	570	32.4
24	65.0-67.5	575	32.2
25	67.5-70.0	585	32.0
26	70.0-72.5	595	31.9
27	72.5-75.0	610	31.8
28	75.0-77.5	620	31.7
29	77.5-80.0	630	31.6

Gas loss, 6% (converted to cc. chg.).

Dry Engler Distillations on Light Fractions

	Light crude	Specification naphthas 375 E.P.	400 E.P.
Per cent	17.9	23.0	39.8
Gravity, ° A.P.I.	57.6	55.4	50.8
I.B.P., ° F	125	127	132
% at 212° F.	58.0	35.0	15.5
% at 284 ° F.	96.5	94.5	54.0
F.B.P., ° F.	310	325	400
Octane No.	72.0	71.0	60.8

	Ref. oil (spread)
Range of cut, %	30.0-73.6
Gravity, ° A.P.I.	36.4
Flash, Abel. ° F.	132
R. O. viscosity	460
Sulphur, %	.04
Ring No.	—1
F.B.P., ° F.	560

	Cracking stock (past ref. oil spread)
Range of cut, %	73.6-95.0
Gravity, ° A.P.I.	29.7
Sulphur, %	.10
Aniline point, ° F.	185

	Cracking stock (past 400 ref. oil)
Range of cut, %	60.2-95.0
Gravity, ° A.P.I.	31.1
Sulphur, %	.12
Aniline point, ° F.	175

Distillation on Vacuum Still Cuts

	1	2	3
Range of cut, %	80-85	85-90	90-95
Temp. liquid, ° F.	450	470	540
Abs. pressure	.10	.10	.10
Gravity, ° A.P.I.	29.9	28.7	26.8
Flash, ° F.	345	410	420
Fire, ° F.	395	450	470
Visc. at 210° F.	35	39	44
Visc. at 100° F.	67	99	Wax
Pour test, ° F.	70	90	100

No Gas Measurement Short Course in 1933

UNIVERSITY of Oklahoma, College of Engineering has announced that the annual southwestern gas measurement short course held at Norman since 1924 will be omitted this year bu will be held again in 1934.

Correction

IN the Article "Heat Flow Diagram of a Two-Stage Distilling Plant" by G. Vandenberg, appearing in The Refiner, February, 1933, beginning on page 47, an error occurred in the last paragraph on page 49. This paragraph should read as follows:—In Ind. Eng. Chem. 1925, pp 1248-49, in a vacuum distillation essay at 10 mm. abs. pressure, it is shown that a sample of 20.7 degrees A. P. I. was 98.5 per cent distillated a temperature ranging from 161° C to 330° C. By interpolating table 17 of Bulletin 97, we find that it required approximately 1,800 to 2,200 Btu. per gallon to perform this high-vacuum distillation, while the same oil, evaporated at 760° F. and under pressure, would require 3,600 Btu. per gallon, or about two times as much. This heat of 3,600 Btu. per gallon is certainly take up and can be verified with the fuel consumption. The explanation is that evaporation of the oil was not under vacuum but under pretty high pressure, somewhere around 40 to 60 pounds per square inch. This mixture moving through the coil has almost the velocity of gas, but the friction coefficient of a liquid and therefore encounters a high pressure drop. Nearer the end of the coil, its pressure will be about equal to the pressure in the vacuum tower and during this semi-adiabatic expansion, its heat will convert the vapors in regular superheated gases.

Supply Men to Entertain Gasoline Association

AT the meeting of the board of directors in Tulsa the last of January the following officers were elected by the Natural Gasoline Supply Men's Associa-

W. D. MOORER

tion for this year: W. D. Moorer, Moorlane Company, president; Bailey W. Vinson, B. W. Vinson Company, first vice-president; A. V. R. Candler, National Supply Company, second vice-president, and M. H. Kotzebue, Tulsa Boiler and Machinery Company, treasurer. Ray E. Miller of Tulsa was re-elected secretary.

Godfrey Brigham, vice-president of North American Car Corporation, has been elected to the board of directors succeeding Jay P. Walker, National Tank Company, who has resigned.

Plans were arranged at this meeting for the entertainment program to be given inconnection with the annual meeting in Tulsa in May of the Natural Gasoline Association of America.

Re-refining in Foreign Countries

NOT only has the reclamation of lubricating oils from crank case drainings become extensively practiced in the United States, where the re-refiners have at least one association formed to further their cause (Refiner, January, 1933, page 34a) but the practice is rapidly gaining headway in foreign countries. These developments have been influencing lubricating oil consumption in this country, and naw bid fair to contribute to a decline in exports of lubricants.

The first installation in Mexico was recently established in Mexico City, where used oil is purchased in quantity at 3 centavos a liter, with the cost of refining bringing the cost to 17 centavos, and this product is sold for 50 centavos, about half the price that average lubricating oils bring in this market. Similar plants are operating in Canada, it is reported, and in England.

In Italy three plants for re-refining of used oils have been recently set up in the north. Two are experimental, one in the Royal High School of Industrial Chemistry at Bologna, the other at the Royal Polytechnic School in Milan. A third, located in Ravenna, has been operating for profit on an industrial scale for about a year, and is now treating 55 to 70 barrels per day. Three other plants of industrial proportions are being erected in Milan, Malnate, and Colonia, Italy. These belong to two groups, one consisting of several professors and technicians of the Milan Polytechnic School and the Milan Laboratory of Chemical Industries, and the others belong to a group which purchased the rights from two professors in the Royal High School at Bologna. Both processes use distillation to eliminate the Volatile portions, treatment with polymerizing agents for forming the precipitates and application of decolorizing agents, and are inexpensive and fully protected by patents.

A. S. T. M. Ballot Favors C. F. R. Motor Test

THE results of the recent letter ballot of the membership of Committee D-2 of the American Society for Testing Materials favors the adoption of the C. F. R. Motor Method for determining octane rating of motor fuels confirming the action taken a month ago by representatives of the committee when adoption was recommended. Results of the balloting were 21 members in favor of adoption and 12 against and is considered sufficiently decisive to enable formal adoption of the method as a tentative standard by April 1. Opposition to the method arose, based on the claims that the new method penalized cracked gasoline somewhat and that in the event important changes in the design of motors for automobiles occurred the method would need revision periodically.

World Petroleum Congress July 20 - 25

THE World Petroleum Congress, organized by the Institution of Petroleum Technologists, London, England, will hold its sessions at the Imperial College of Science and Technology, South Kensington, beginning Thursday, July 20 and ending Tuesday, July 25, with two meetings daily.

The preliminary program includes activities of four divisions namely, geological section, engineering section, refining and chemical section, and the standardization section, each division holding two sessions daily. The geological section will present papers and discussions dealing with modern developments in geological exploration, geological significance of the regional distribution of oil fields, and geological aspects of oil field development. The engineering section will discuss drilling, production, gas collection and treatment, oil collection and treatment and transport of oil.

The refining and chemical section activities include hydrogenation, bituminous materials, solvent extraction, kerosene, the modern refinery, and the standardization section will study testing of bituminous materials, gum determination, viscosity and its expression, lubricating oils, knock-rating motor and aviation gasoline, and fuel for high speed Diesel engines and knock-rating of Diesel engines. A joint session of all four divisions will be given over to international cooperation in standardization and the formal adoption of resolutions passed during the congress.

Arrangements are also being made for the following functions: Reception and private view of the International Oil Industries Exhibition, Wednesday, July 19. A dinner by the council of the Institution of Petroleum Technologists to the foreign delegates to the congress on Thursday evening, July 20. An exhibition of films illustrating the Petroleum Industry, Thursday, evening, July 20. A banquet open to all members of the congress will be held on Monday evening, July 24, and a smoking concert on Tuesday evening, July 25. Arrangements are being made for visits to works of interest on Saturday, July 22 and for excursions Sunday. Further details regarding the congress can be secured by communicating with the Secretary, World Petroleum Congress, Aldine House, Bedford Street, London, W. C. 2.

Symposium on Lubricants At A. S. T. M. Meet

THE 1933 Regional Meeting of the American Society for Testing Materials was held in New York City on March 8 at the Hotel New Yorker. General arrangements for the meeting were under the supervision of the New York District Committee, and the Technical Committee on Motor Oils of A.S.T.M. Committee D-2 on Petroleum Products and Lubricants arranged the program, with the Metropolitan Section of the Society of Automotive Engineers cooperating. Prominent petroleum and automotive technologists presented papers in the afternoon and evening sessions devoted to the Symposium.

The Committee on Motor Oils when it initiated its extensive research and testing work a few years ago realized that some of the most controversial points in connection with lubrication of automotive equipment had to do with the following factors: viscosity, pour point, carbon residue, oil consumption and service changes and their effects. Several groups were appointed to study the significance of these factors and later another group initiated research studies on the effect of design on lubrication. Each of these groups made a thorough study of existing literature and carried out a considerable amount of work in laboratories and plants of the various members. There has thus been prepared an outline of what is considered to be the most pertinent information and the significance of the facts developed to the questions involved.

The officers of the committee realize that many of these highly controversial questions are still a long way from solution and that it would be desirable to present various questions to a meeting of the society and other groups interested, including the Metropolitan Section of the Society of Automotive Engineers.

PLANT ACTIVITIES

Distillation Unit: Coltex Refining Company, Colorado, Texas, building new tube still crude oil unit. Plant owned jointly by Anderson Pritchard Oil Corporation and Standard Oil Company of California.

Asphalt Plant: Standard Oil Company of Ohio, Cleveland refinery, building 1200-barrel asphalt emulsion plant, including tankage, drumming plant and loading rack to cost $100,000.

Distillation Unit: Oil Creek Refining Company, Titusville, Pennsylvania, adding 1500 tube still distillation unit, contract to Alco Products Inc.

Refinery:—The Texas Company and Socony-Vacuum Corporation are again mentioned in reports as contemplating erection of jointly owned refinery in Argentina. Petroleum World, London, England, states it is a $3,000,000 project, contingent upon assurances from Argentine government that there will be no increase on duty on crude oil.

Enlargement: Globe Oil & Refining Company, Lemont, Illinois, awarded contract to Winkler-Koch Engineering Company for enlargement of plant capacity to 8,000 barrels, including skimming and cracking capacity.

Refinery: Smith Close Company, Sheridan, Wyoming, building 150 barrel skimming plant to operate on Osage crude.

Refinery: The Fillman-Hampton Oil Company, Wichita Falls, reported planning 250 barrel skimming plant, Stamford, Jones County, Texas.

Refinery: Caldwell Refining Company, Caldwell, Idaho, is reported planning $150,000 oil refinery.

Improvement: Cities Service Company, 60 Wall Street, plans to alter and install new distillation equipment at East Braintree, Massachusetts, refinery.

Rebuild: Continental Oil Company, Florence, Colorado, repairing damage to distillation equipment caused by fire.

Addition: Eclypse Refining Company, New Castle, Wyoming, plans to construct addition to its refinery, reported cost $30,000.

Modernize: Excell Petroleum, Ltd., 6376 Clark Street, Montreal, Quebec, Canada, plans to spend $28,000 altering and modernizing its plant.

Improvement: Keystone Refining Company, 12800 Northampton Avenue, Detroit, Michigan, plans to improve its plant at estimated cost of $75,000.

Refinery: Lloyd Refining Company, 329 Rose Park Drive, Toronto, Ontario, Canada, acquired site at Port Credit, Ontario, and plans erection of refinery to exceed cost of $50,000.

Refinery: Southern Crude Oil Refining Company, Texarkana, Arkansas, reported planning installation of refinery in new Miller County field. P. J. Stapp in charge. Reported cost, $40,000. (Refiner, Feb. 1933, p. 36a).

Stabilizer: Magnolia Petroleum Company, Corsicana, Texas, erecting gasoline recovery and stabilization system.

Sold: The State of Texas purchased the V. O. E. Refining Company, Gladewater, Texas, at auction held by Gregg County sheriff, for $5050. R. G. Watters, assistant attorney general, and C. A. Pacton, State Comptroller's Department, bought the plant for the state.

Refinery: Crescent Refining Company, Holdenville, Oklahoma, started erecting 1000-barrel skimming plant late in February. Victor H. Smith, Tulsa, vice-president, P. I. Tinkler, superintendent. Part of equipment from small plant at Wewoka, Oklahoma.

Refinery: Simrall Refining Company, operating plants at Horse Cave, Kentucky, and Amherstburg, Ontario, Canada, propose construction of 1500-barrel refinery at Owensboro, Kentucky.

Small Plant: Golden Petroleum Company, building small refinery 7½ miles north of Ballinger, Texas, near the Abilene & Southern Railroad, to process oil from the MacMillan pool, Runnels County.

Refinery: Hyrogas Refineries, Ltd., will erect 250-barrel plant at St. Catherine, Ontario, Canada, to produce new motor fuel called "Hydrogas."

Cracking: Continental Oil Company at Glenrock, Wyoming, let contract for erection of 3000-barrel combination skimming and cracking unit, to cost $500,000. At Denver, a new absorption and stabilization plant is being installed. At Ponca City two Cross type cracking units are being modernized, contract to M. W. Kellogg Company. Total cost of these improvements $750,000.

Sale: Cosden Oil Company properties are to be offered for sale at the site of the refinery east of Big Spring, Texas, on March 28, subject to existing liens and without guarantee as to condition.

Refinery: Compania Espanola de Petroleos (Campsa) according to Spanish reports is planning erection of a refinery to be under control of the Spanish monopoly at Barcelona. Other reports state a refinery will be placed at Couta, Spanish Morrocco, to produce asphalts, chiefly.

Cracking Plant: Yacimientos Petroliferos Fiscales (Argentine Government) has been authorized to add a fourth cracking unit at the La Plata refinery, Argentina, South America.

Purchase: Phoenix Refining Company, operating skimming plants at Pettus, Houston, and Dallas, recently purchased the U. S. Refining Company plant at New Orleans.

Stabilizer: Bell Oil & Gas Company at Grandfield, Oklahoma, refinery, has let contract to Burrell-Mase Engineering Company for construction of vapor recovery and stabilization unit. Work now in progress revamping Dubbs cracking installation.

Reorganization: Pan American Petroleum & Transport Company (Standard Oil Company (Indiana) subsidiary) will consolidate with Mexican Petroleum Company, American Oil Company (Blaustein interests, also controlling Crown Oil & Refining Company, Houston, Texas) and Lord Baltimore Filling Stations, Inc., but retain corporate names. The Baltimore refinery will be increased to about 30,000 barrels capacity, including distillation and cracking facilities. Crown Oil & Refining Company will modernize battery of Holmes-Manley units at Houston. Mexican Petroleum Corporation, in addition to the Baltimore plant, has refineries at Savannah, Georgia and New Orleans, but no confirmation is available to the report that these plans will be modernized and cracking facilities added.

Distillation Unit: Phillips Petroleum Company, Kansas City, Kansas, refinery has completed cracking installation and now erecting new crude oil distillation unit replacing former crude oil system, with further additions planned.

Refinery: Henry Dickason, Denver, Colorado, and Roy Miller, refinery engineer, Wichita, Kansas, are reported planning erection of 500-barrel skimming plant at Great Bend, Western Kansas.

Operating: McNutt Oil & Refining Compan, El Paso, Texas, is operating its new 1000-barrel plant. C. M. McNutt, president, Emil Geppelt, vice-president.

Operating: McMurray Refining Company, north of Arp, East Texas, 2000-barrel cracking plant, started operating late in February, running topped crude from nearby skimming plants. R. J. McMurray, president. W. Lee Woods, superintendent.

Refinery: Eagle Refining Company was recently organized in Cleveland, Ohio, to establish and operate a refinery. Incorporators are B. D. Kuth, Corinne Sobatta and B. D. Bradley.

Cracking Unit: Constantin Refining Company, Overton, East Texas field, has installed cracking unit to operate on topped crude from Overton Refining Company's nearby skimming plant.

Refinery: Terry Carpenter, jobber, Scottsbluff, Nebraska, building small skimming plant to process crude from Wyoming fields.

Refinery: Gulf Refining Company reported negotiating for refinery site at St. John, New Brunswick, Canada, east of the city on property of the St. John Harbor Commission. Estimated cost $750,000.

Acquisition: Central Refining Company, near Henderson, East Texas, field, has been taken over by M. J. Grogan and B. P. Crittenden, both formerly with Louisiana Oil Refining Corporation, Shreveport, who have formed a new corporation in association with F. W. Burford, president, East Texas Refining Company. Capacity, 10,000 barrels, topping, operating.

Refinery: The Tyler Refining Company of Texas recently organized to build a refinery in the East Texas field, probably near Arp. J. E. McKee, president, other incorporators are A. F. Knappenberger, R. S. Harper and E. C. Holt.

Refinery: Wyoming Oils, Inc., recently completed a 200-barrel refinery at Mills, near Casper, Wyoming, and will run Pilot Butte crude.

Purchase: Hercules Gasoline Company, Vernon, Calif., refinery was purchased by A. O. Wehinger and C. F. Homan, New York, through H. F. Laugharn, trustee in bankruptcy Febraury 17. Will recondition and operate for skimming and Jenkins cracking unit. Walter Steiner, superintendent. Consideration, $400,000 and $75,000 bond posted.

Storage: Sinclair Refining Company at Houston, Texas, is adding to storage erecting

seven 90,000 barrel steel tanks. Reports state similar additions are to be made at Marcus Hook, Pennsylvania.

Reforming Unit: Pure Oil Company, Toledo, Ohio, refinery will erect a new naphtha reforming unit, beginning work in the next month. At Smiths Bluff, Texas, new "S. R." type fractionating columns will be installed on one pipe still unit. At Marcus Hook the compression plant is being enlarged.

Refinery: Goforth and Landers Refinery will will be erected on the Taylor Lee lease, east of Gladewater, East Texas field, capacity 2500 barrels, reported cost $100,000, by W. C. Goforth and H. D. Landers, Oklahoma City.

Refinery: A. B. Foshee, Gladewater, East Texas field, will build a $25,000 refinery inside the western limits of Gladewater.

Refinery: The Hart-Field Refining Company, headed by C. A. Heartfield, Shreveport, has been organized to build a small refinery at Kilgore, East Texas field.

Rebuilding: Panama Refining Company, small skimming plant near Kilgore, East Texas field, will rebuild after destruction by fire.

Refinery: Roy Carter, Wichita Falls, reported planning erection of 500 barrel skimming plant 1½ miles north of the city and office building and service station in the business section of the city.

Water Plant: Shell Petroleum Corporation at Arkansas City, Kansas, awarded contract to Water Mining Corporation, Tulsa, for single unit water mine to have capacity of 6,000,000 gallons daily.

Plant: J. B. Paddy, Gladewater, East Texas field, building 200-barrel skimming plant, on Texas and Pacific Railroad.

Plant: Dutch Rowe, Gladewater, East Texas field, building 200 barrel skimming plant one mile east of Gladewater.

A LETTER TO THE EDITOR

Your editorial in the January number of The Refiner interested me very much. In this you state that the petroleum industry seems to have a surplus of almost everything. As I see it, there appears to be a dearth of organized effort for the development of any outlet for petroleum products. Individual refiners are attempting to develop markets for burning oils, road oils and asphalts, but there is sorely needed an organized movement by the industry to encourage the use of petroleum products in other fields.

It is true that the industry is forced to carry an unjust portion of the cost of government through excessive taxes. This tax burden will probably continue to increase until the organized efforts of the industry are strong enough to turn public sentiment from its present trend.

There is a market available to the oil industry that has been overlooked for more than a decade. This is in the field of highway construction and maintenance. During the past ten years the highways department of the country have had enormous sums to spend for road construction and maintenance but the oil industry has profited very little from these expenditures. Road oils and asphalts derived entirely from petroleum are best suited for the many varied requirements of the highways. It will be admitted that the public desires weatherproof roads serviceable at all seasons of the year, and that this desire applies to all roads not improved with mud-proof dustless surface. Thus the potential market for a material which will provide such highways is almost unlimited. The oil industry has the only material which is suitable and usable for all types of roads. Speaking strictly in the terms of meeting the traffic requirements of our highways, there is a relatively small mileage of roads where it would be economical to use steel plates for surfacing. There is a larger mileage where a brick surfacing would be economical and practicable. Taking the country as a whole, these road types would be limited in mileage to roads of very heavy traffic. The concrete pavement being the cheaper type, would have a larger use. But, of the 3,200,000 miles of public highway only a small mileage could justify the concrete type from the viewpoint of traffic requirements. On the other hand, oiled roads can be constructed as cheaply at $1,000.00 a mile for very light traffic roads and for the more traveled arteries, pavements costing $12,000.00 to $16,000.00 per mile. In between these limits, oil and asphalt can be constructed for the particular requirements of the highways.

If the oil industry will awaken to the fact that it has a product better suited to highway needs than any other industry, they will find a market awaiting that product.

Very truly yours,

A. R. Losh,
Manager, Asphalt Division,
Anderson-Prichard Oil Corporation.
Oklahoma City, Oklahoma.

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New Equipment for the Modern Plant

1. Potentiometer Stabilog

FOXBORO COMPANY

Foxboro Company of Foxboro, Massachusetts, announces the Potentiometer Stabilog—an instrument combining the many features and advantages of Stabilog Control and Potentiometer temperature measurement.

Through the development of this instrument, the automatic control provided by the Stabilog System is made available for temperatures up to 2800° F. (1500°C.). In addition, the long-distance feature of the Potentiometer measuring system makes the instrument particularly valuable where there is a great distance of height between the point of measurement and the controller. Where it is desirable to use this instrument on the lower temperature ranges, the Wheatstone Bridge and resistance bulb measuring system is used.

The Potentiometer Stabilog is a non-recording instrument but it is so constructed that a record of its operation may be made on a Foxboro Recording Potentiometer Pyrometer using the same thermocouple. One multiple-point Recorder may be hooked up with as many as six Potentiometer Stabilogs thus recording and controlling from the same thermocouples.

2. Boiler Tubing

STEEL AND TUBES, INC.

Steel and Tubes, Inc., Cleveland, Ohio, a subsidiary of the Republic Steel Corporation, announces the development of electric resistance weld boiler tubes, to be marketed under the trade name of "Electrunite Boiler Tubes." These new tubes have been recommended by the American Society of Mechanical Engineers for use in pressure boilers, and bear the approval of both the United States Department of Commerce Steamboat Inspection Service and the American Bureau of Shipping.

The tubing is formed from strip steel continuously, the strip being passed through a series of forming rolls. The round butted tube thus formed then passes under revolving wheel-like copper electrodes where current travels from electrode to electrode through the butted seam of the tube. At the same time, pressure is applied which, together with the heat which is below the fusion temperature and which is confined to an area no larger than a pinhead, completes the weld.

This new type of boiler tubing is available in all sizes up to 5 inches O. D., in copper bearing, nickel steel and Toncan iron, as well as the usual open hearth steel.

3. Double Reduction Worm Gears

DE LAVAL STEAM TURBINE CO.

De Laval Steam Turbine Company, Trenton, N. J., announces a new line of double reduction gears in which the simplicity of the combined double reduction design has been retained, the high speed gear wheel being mounted upon the slow speed worm shaft, but a greater flexibility in the arrangement of the drive has been gained by using separate housings for the high and slow speed gear.

All gear tooth and worm surfaces and the bearings are lubricated by a splash system, the high speed gear wheel and the slow speed worm dipping in an oil bath in the casing; a system requiring only the maintenance of the proper oil level. The high speed worm shaft and the shaft carrying the high speed gear wheel and the slow speed worm, have ball bearings. The slow speed shaft has plain sleeve bearings, or in units in which the slow speed shaft is horizontal, may be fitted with tapered roller bearings.

De Laval Double Reduction Worm Gears

4. Feed Water Regulator

NORTHERN EQUIPMENT COMPANY

Northern Equipment Company, Erie, Pa., announces an improved design of the Copes Series Type Feed Water Regulator. This regulator feeds the boiler in accordance with steam flow, with compensation for water level. The new design has been developed as a result of tests made at Bohlen Power Station in Germany.

A new type of mechanical transmission makes it possible to locate the steam flow thermostat near the connections to the steam header. This

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REFINER AND NATURAL GASOLINE MANUFACTURER,
Houston, Texas, U. S. A.

Please see that I am supplied, without obligation, additional information on New Equipment Items Nos.....described in March, 1933, issue of REFINER.

Name .....

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simplifies erection and adjustment of the regulator, assuring more accurate results.

With the new Series Type Regulator, it is an easy matter to increase or decrease the influence of either steam flow or water level thermostat. This means that almost any desired proportion between steam flow and water level can be obtained without difficulty.

The Series Type Regulator can be equipped with either direct-acting or hydraulically-operated control valve, or with a combined feed flow and water pressure regulating valve. Present installation of Copes Feed Water Regulators equipped with tension type thermostats may be changed over to Series Type Regulators at moderate cost.

5. Recorder Case

LEEDS & NORTHRUP

Leeds & Northrup, 4901 Stenton Avenue, Philadelphia, Pennsylvania, announces a new multi-purpose case for the Micromax Recorder.

This case is dust-tight, and vapor-tight, when desired. It can be supplied for mounting in any position as specified—either flush in panel, on front of panel or wall, or on table or bench.

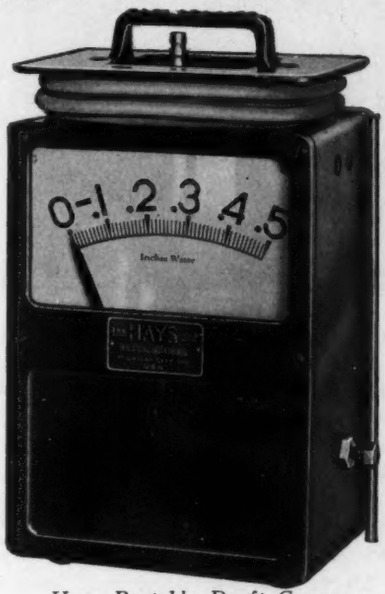
The case is sealed by simply turning the handle, thus pressing the door tightly against a rubber gasket. The lock is outside the gasket, and hence vapors cannot filter into the case through it. The switches for motor, lights and control circuit are operable externally, and are vapor-proof, so that these units may be shut off before the door is opened and outside vapors reach the mechanism. Leads to the recorder can be brought in through either conduit connections or a pothead.

The mechanism can be swung completely out of the case, so that it is accessible from all sides. The machine is adapted to all types of control, and is furnished in any of the standard null-type measuring circuits.

6. Portable Draft Gauge

THE HAYS CORPORATION

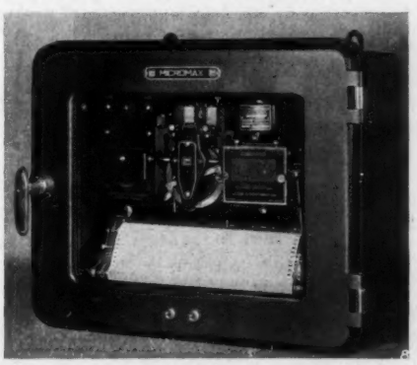
The Hays Corporation, Michigan City, Indiana, announces a new portable, dry type draft gauge incorporating a number of features which the manufacturer outlines as follows:

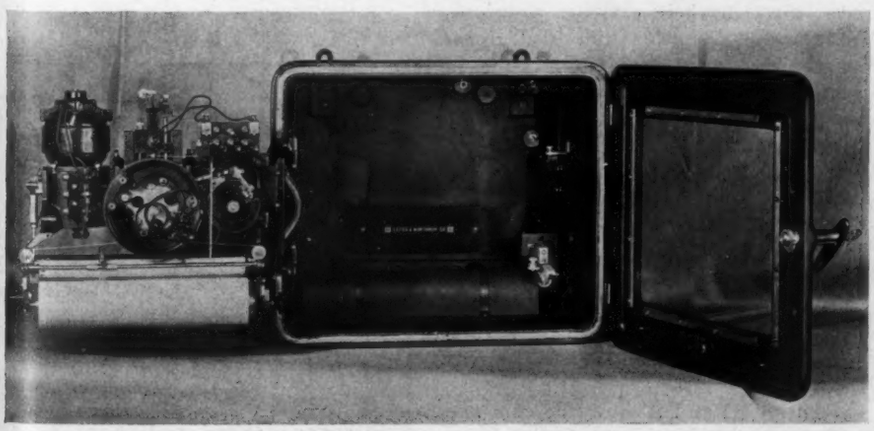


Hays Portable Draft Gauge

Uses no liquids, and can be set up in 30 seconds for service; black laquer finished cast aluminum case with glass window and slip-over metal cover; carrying handle for portability; reel for carrying rubber tubing; clips for carrying metal tube which is inserted in smoke pipe to get draft reading; weight, 4¾ pounds; overall dimensions, 5 by 4 by 9 inches; scale length, three inches.

The Hays Corporation states the gauge does not require leveling.





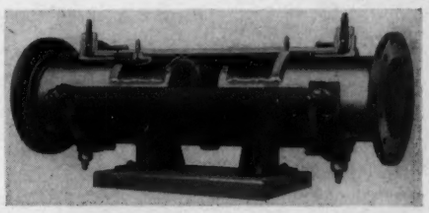
View showing ready accessibility of L&N Micromax Recorders in new multi-purpose case, and, above, the case closed.

7. Expansion Joint

YARNALL-WARING COMPANY

Yarnall-Waring Company, Chestnut Hill, Philadelphia, announces a new "Gun-Pakt" expansion joint permitting packing under pressure.

The fixed gland has four or more bosses to which are attached screw guns which force into the stuffing box a semi-plastic, heat resistant packing. This packing, inserted in small plugs, passes through channels in the gland ring, impinging on deflector vanes which distribute it evenly around the packing space.



Yarnall-Waring Expansion Joint

According to the manufacturer, the joint may be easily repacked while in service, without removing the gland or the old packing, thereby eliminating shutdowns for repacking.

Alemite fittings are provided for lubrication of the sliding sleeves and cylinder guides and packing.

The joint is of all steel construction but with the sliding sleeves chromium plated. There are internal limit stops and the anchor bases are "welded on any position." The joints are made single or double ended, flanged or welding type, in sizes from two to 24-inch diameters, for working pressures up to 400 pounds.

8. Escapement Type Integrator

BAILEY METER COMPANY

Bailey Meter Company, 1050 Ivanhoe Road, Cleveland, Ohio, recently announced an escapement type integrator which gives the total flow in gallons, pounds or other units, on a six-figure counter.

The principle of operation is diagrammatically represented by Figure 2. A heart-shaped cam, which has a uniform angular rise, is geared to a Warren synchronous motor and rotated at the rate of two revolutions per minute. By means of a friction clutch between the cam and the escape wheel, the motor

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"ESS & JAY" again scores with this

NEW TYPE GATE VALVE

Noteworthy advantages for oil industry uses are to be had in the new S & J quick opening gate valve. Any combination of flanged or male and female connections can be arranged on the valve. Seats and discs of stainless steel. Bodies made of bronze, aluminum, cast iron or cast steel. Sizes are 2, 2½, 3 and 4 inch standard. Can be made of any metal for special service requirements. Send for Pamphlet No. 134.

S & J also makes tank vents, automatic gauges, gauge covers, swingline equipment, vapor recovery regulators, flame arrestors, level control equipment and internal hydraulic safety systems.

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See previous ads for other exclusive features.

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The pipe connecting the Campbell Regulating Element with the Control Valve can slope down or up and can be of any size, length, or material. This is only *one* of the reasons why the Campbell is so easy to install and is so popular. No floats, no thermostats, no generators, no moving parts in the Regulating Element. Nothing to get out of order. Costs least to install.

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Clip this to your letterhead, check the items in which you are interested, and we will gladly send prices and data. No obligation.

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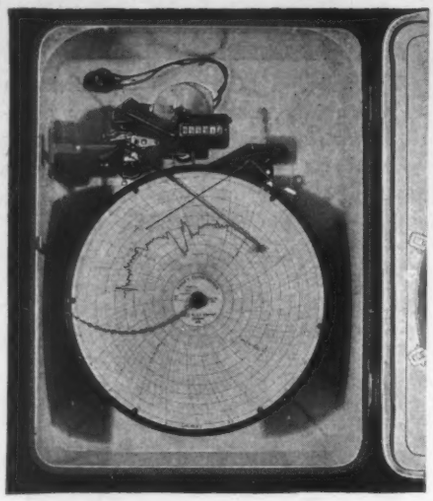
- ☐ Swing Joint Fittings
- ☐ Bronze Unions
- ☐ Thermostats
- ☐ Balanced Valves
- ☐ Control Valves



Bailey Integrator

also drives the escape wheel and integrator counter at constant speed when the pawl is not engaged. When the pawl engages with the escape wheel, the integrator counter is held stationary, but the friction clutch allows the cam to continue rotation.

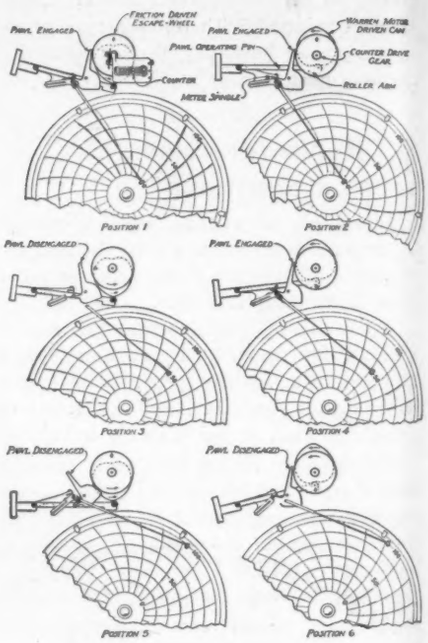
The roller arm is pivoted near its left end to the flow mechanism, so that the position of the pivot varies only with changes in the rate of flow. The right end of the roller arm moves up and down under the action of the rotating cam, causing the pawl operating pin to move up and down also. It is this operating pin which is responsible for engagement and disengagement of the pawl with the escape wheel.

Positions 1 and 2 show the flow recorder at zero rate of flow. In Position 1, the cam and roller are at maximum throw, while in Position 2, they are at the point of minimum throw. In both of these zero rate of flow positions, which represent extreme cam positions, the integrator counter is stationary because the path of the pawl operating pin does not come sufficiently low to disengage the pawl.

Positions 3 and 4 also show the cam and roller in their extreme positions, but the flow recorder is at 50 per cent of maximum capacity. The increase in rate of flow has resulted in lowering the left end of the roller arm, thus lowering the path travelled by the operating pin. Consequently, during 180° rotation of the cam, the pawl remains engaged with the escape wheel, but during the remaining 180° rotation, it is kept disengaged by the pin. Under these conditions, the integrator runs 50 per cent of the time, which is correct when the rate of flow is at 50 per cent of maximum.

Positions 5 and 6 show the cam and roller in similar positions, but with the rate of flow increased to 100 per cent. Under these conditions, the pawl operating pin keeps the pawl disengaged during 360° rotation of the cam, consequently, the integrator runs continuously.

According to the manufacturer, this escapement type integrator has proved to be very accurate since its operation is governed by the rate of flow at each engagement and disengagement of the pawl. Since the pawl engages and disengages during each revolution of the cam for all rates of flow between 0 and 100 per cent, the integrator total is adjusted to the prevailing rate of flow four times each minute.



9. Magnetic Clutch Flow Controller

C. T. TAGLIABUE MANUFACTURING COMPANY

C. J. Tagliabue Manufacturing Company, Brooklyn, New York, announces the TAG magnetic clutch flow controller. A complete line of orifice meters is also available in this construction.

It is described by the maker as follows:

"Since elimination of a pressure-

PULMOSAN SAFETY DEVICES

- RESPIRATORS *Dust and Fumes*
- GOGGLES
- FIRE FIGHTING EQUIPMENT
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R-110 Dustpruf Respirator

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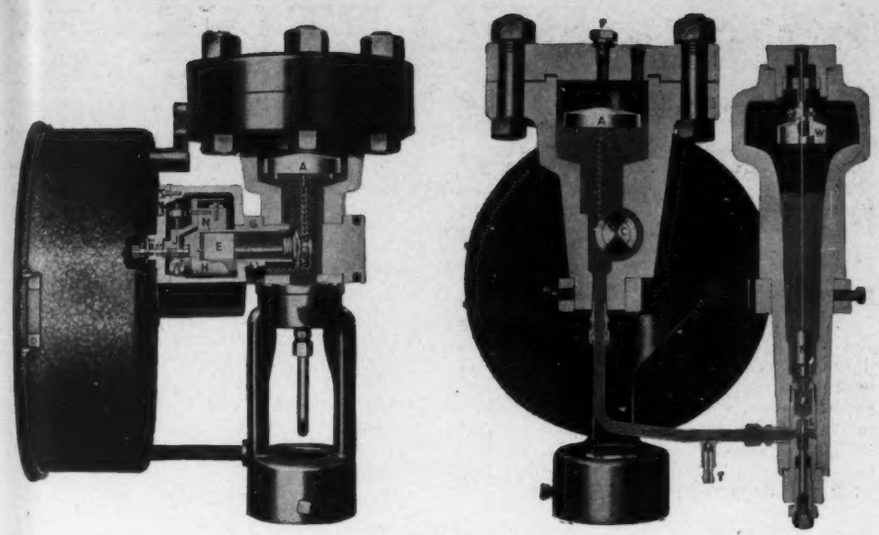

Tagliabue Magnetic Clutch Flow Controller

tight bearing would do away with friction, binding, leakage and maintenance at that point, this bearing was discarded in favor of a perfected magnetic clutch. This departure from the usual practice brought with it two further advantages. (1) A regular construction suitable for 2500 pounds working pressure. (2) The ability to locate all internal parts so that they are immersed in the mercury and protected by it against moisture, dirt and corrosion. All internal parts including the float are stainless steel, thus realizing a corrosion-proof construction and making sealing chambers unnecessary."

The TAG magnetic clutch operates the pen. When the float moves the rotor turns instantly. When the rotor turns, the Cobalt steel magnets turn the same amount because the rotor and magnets are locked together by the magnetic field. The rotor turns in a closed-end cylinder of non-magnetic stainless steel. The magnets outside this cylinder are mounted on ball bearings and transmit the movement to the pen. The magnets are shielded and are housed in a dust-proof case.

The low pressure leg can be interchanged by the user so that the differential range can be made either 20-inch, 50-inch, 100-inch or 250-inch. A 100-inch range volumeter is also available which enabled use of a chart graduated uniformly in units of flow which is particularly desirable for rate-of-flow control work instead of the "progressive" chart.

Other features set forth by the manufacturer are: improved orifice holding ring with meter connections allowing use of standard flanges; universal mounting for 2-inch vertical pipe or wall (surface) or panel (flush) mounting; manometer chambers of forged steel; stainless steel needle dampening valve adjustable during operation; improved stainless steel check valve positively preventing blowing out mercury; balancing control feature on controllers preventing "hunting"; pilot valve instantly reversible from direct to reverse acting."

The Safe, Economical and Dependable Drive

—Coppus Steam Turbines are comparable in cost to electric motors with the added advantage of a wide speed range. And they eliminate the hazards of sparking and power shutdowns.

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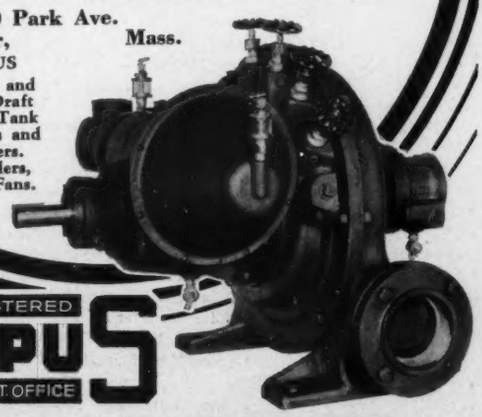

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CATALOGS . . . BULLETINS

Helpful Publications Which Manufacturers Will Be Glad to Send Free for the Asking

Diaphragm Pump

T. Shriver & Company, Hamilton Street and Franklin Avenue, Harrison, New Jersey, announce publication of an eight page illustrated bulletin describing a diaphragm pump designed for pumping materials that are hard to pump.

Steam Turbines

General Electric Company, Schenectady, New York, has available for distribution Catalog GEA-1145B, superseding GEA-1145A, and devoted to steam turbines for the mechanical drive of pumps, fans, compressors, blowers, pulverizers and stokers.

Chromium Pipe and Tubes

National Tube Company, Frick Building, Pittsburgh, Pennsylvania, has available for distribution Bulletin 20, a 16 page illustrated booklet telling of four to six per cent chromium seamless pipe and tubes and containing a chart showing graphically results of corrosion tests.

Electric Heat Units

General Electric Company, Schenectady, New York, has available for distribution Catalog GEA-1520A, superseding GEA-1520 and devoted to electric heating units and devices for small jobs.

Stainless Steel

Republic Steel Corporation, Youngstown, Ohio, has available for distribution Bulletin 217-B, devoted to the application, fabrication, properties, shapes and available finishes of Enduro stainless steel.

Recording Thermometers

The Foxboro Company, Foxboro, Mass., is distributing Foxboro's Recording Thermometer Bulletin 169-1 in which are described the Anti-Ambo Thermometer, the Portable Temperature Recorder, the Rotax Controller, and a new section on bulbs. A complete table of recorder charts is presented.

Control Instruments

The Bristol Company, Waterbury, Conn., has prepared its new catalog No. 1204, covering Vapor Tension type Thermometers, Class 11 for Recoring, Controlling and Indicating, which is accompanied by engineering information and data on methods of application of various instruments.

Cooling Towers

The Marley Company, 1737 Walnut St., Kansas City, Missouri, is distributing Bulletin No. 39 describing the new Marley Small Spray Type Cooling Towers.

Electric Motor

U. S. Electrical Manufacturing Company, Los Angeles, California, has prepared a new illustrated bulletin describing its recently developed U. S. Syncrogear Motor, a new type of geared motor furnished for any speeds from 2 to 10,000 RPM. The company is also distributing a bulletin describing its new U. S. Varidrive motor, with variable speed combinations from 25 RPM to 10,000 RPM.

Reduction Unit

Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, is distributing bulletin 1164, illustrating and describing its motor reduction units, giving details of construction and rating.

Linings

Stebbins Engineering & Manufacturing Company, Watertown, New York, is distributing Bulletin No. 1, describing its acid, alkali and corrosion resisting linings for industrial equipment.

Splash Proof Motors

Louis Allis Company, Milwaukee, Wisconsin, is distributing Bulletin 512, illustrating and describing its Type F splash proof electric motors.

Water Well Piping

Republic Steel Corporation, Youngstown, Ohio, has prepared a well illustrated folder "The Ideal Pipe for Water Wells," presenting engineering and practical data dealing with water wells and their piping.

Temperature Regulator

Atlas Valve Company, 282 South Street, Newark, New Jersey, is distributing a bulletin describing its Victor, self contained vapor type temperature regulators for liquids, giving engineering information and prices.

Lathes

South Bend Lathe Works, South Bend, Indiana, has issued a new General Catalog, No. 93. The 72-page catalog illustrates, describes and prices the complete line of South Bend Lathes in sizes from eight-inch swing to 24-inch swing. Illustrations and descriptions of the many attachments with which a screw cutting lathe can be fitted, are included.

Plants

Foster Wheeler Corporation, 165 Broadway, New York, has prepared an illustrated catalog describing its refinery equipment installations, marine equipment, steam generators, superheaters, economizers, air heaters, ash dischargers, condensers, centrifugal pumps, steam jet air pumps, evaporators, cooling towers, and vacuum refrigeration systems.

Metals

The International Nickel Company, Inc., 67 Wall Street, New York, has ready for distribution Bulletin T-4, "Methods for the Fabrication of Nickel Clad Steel, and Bulletin T-5, "Engineering Properties of Monel Metal, presenting technical information of value to engineers.

Insulation

Eagle-Picher Lead Company, Joplin, Missouri, is distributing a 24-page well illustrated booklet dealing with its Eagle "66" insulating cement, discussing its application in the refining industry.

Items About Manufacturers

R. S. Lord, president of Hope Engineering Company, died February 5 at his home in Mount Vernon, Ohio, as the result of an operation for appendicitis, the complication following the operation being diagnosed as peritonitis.

Mr. Lord, prominent in civic activities in and around Mount Vernon for the past 17 years, was a trustee of Ohio Wesleyan University, director of the local Y. M. C. A., a deacon in the Gay Street Methodist Episcopal Church, and president of the Lord-Kelly Auto Company. He was one of the organizers of Hope Engineering Company, holding the office of secretary, treasurer and general manager when the company was organized in 1906. He was active in Masonic and Modern Woodmen of America work.

Eagle-Picher Lead Company, general office at Cincinnati, Ohio, T. C. Carter, sales manager, and Harold Powell, district sales manager at Cincinnati, maintains insulation division offices at New York, where Glen J. Chistener is district sales manager; at Chicago, where J. H. Lease is district sales manager, and at Joplin, Missouri, where H. R. Shidel is district sales manager and C. B. Lynde is field representative.

The Oster Manufacturing Company, of Cleveland, Ohio, manufacturers of pipe and bolt threading equipment, in January passed the fortieth anniversary of its founding and the third of its merger with Williams Tool Corporation of Erie, Pa.

The combined companies possess more than 70 years experience and service in the manufacture of equipment used in the threading and cutting of pipe and bolts, by industry as a whole, an asset of which they are very proud.

Although the individual corporate names The Oster Manufacturing Company and Williams Tool Corporation will not lose their identity, a new letterhead has been designed, and the combination will henceforth be known as Oster-Williams, Cleveland, Ohio.

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